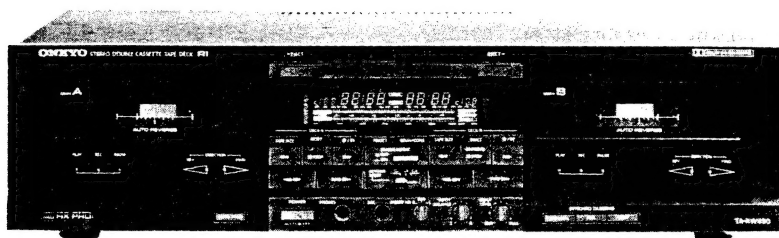


# ONKYO SERVICE MANUAL

## STEREO CASSETTE TAPE DECK

### MODEL TA-RW490



Black model

UDN, UDC, UD	120V AC, 60Hz
UG	220V AC, 50Hz
UW	120 or 220V AC, 50/60Hz
UQA, UQB	240V AC, 50Hz

#### SAFETY-RELATED COMPONENT WARNING!!

COMPONENTS IDENTIFIED BY MARK  $\triangle$  ON THE SCHEMATIC DIAGRAM AND IN THE PARTS LIST ARE CRITICAL FOR RISK OF FIRE AND ELECTRIC SHOCK. REPLACE THESE COMPONENTS WITH ONKYO PARTS WHOSE PART NUMBERS APPEAR AS SHOWN IN THIS MANUAL.

MAKE LEAKAGE-CURRENT OR RESISTANCE MEASUREMENTS TO DETERMINE THAT EXPOSED PARTS ARE ACCEPTABLY INSULATED FROM THE SUPPLY CIRCUIT BEFORE RETURNING THE APPLIANCE TO THE CUSTOMER.

#### SPECIFICATIONS

Track System:	4-tracks, 2-channels
Erasing System:	AC erase
Tape Speed:	4.8 cm/sec. (1-7/8 i.p.s.) 9.6 cm/sec. (3-3/4 i.p.s.) (high speed dubbing)
Wow and Flutter:	0.06% (WRMS)
Frequency Response:	20–15,000Hz (Normal) (30–14,000Hz $\pm 3$ dB) 20–26,000Hz (High) (30–15,000Hz $\pm 3$ dB) 20–17,000Hz (Metal) (30–16,000Hz $\pm 3$ dB)
S/N Ratio:	Dolby NR off: 58dB (metal position tape) A noise reduction of 10dB above 5kHz and 5dB at 1kHz is possible with Dolby B NR. A noise reduction of 20dB at 5kHz is possible with Dolby C NR.
Input Jacks:	Microphone jack: 1 Input sensitivity: 1mV/600 ohms Input impedance: 5.6 kohms Line IN: 2 Input sensitivity: 60mV Input impedance: 50 kohms
Outputs:	Headphone jack: 1 Optimum load impedance: 8 to 200 ohms Line OUT: 2 Standard output level: 500mV (0dB) Optimum load impedance: over 50 kohms
Motors:	DC servo motor x 2; DC motor x 2
Heads:	REC/PB: special hard permalloy x 2; Erase head: ferrite x 2

**ONKYO**  
AUDIO COMPONENTS

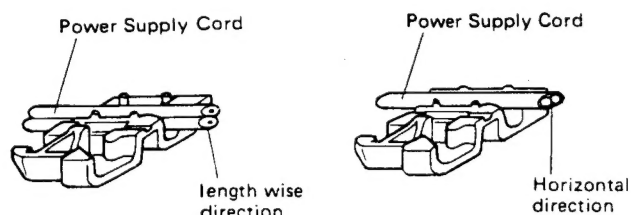
Power Supply:	AC 120V, 60Hz
Power Consumption:	37 watts
Dimensions:	435(W) x 115(H) x 334 (D) mm (17-1/8" x 4-1/2" x 13-1/8")
Weight:	6.2 kg. (13.6 lbs.)

Specifications and external appearance are subject to change without notice because of product improvements.

## SERVICE PROCEDURES

### 1. Replacement of power supply cord

There are two power supply cord outlets on the strainrelief. Insert them in prescribed direction to ensure safety. AS-UC-3 (UD<120V> model) should be inserted lengthwise and other types of cords should be inserted horizontally.



### 2. Instruction resistance measurement

Connect the insulating-resistance tester between the plug of power supply cord and chassis.  
Specifications; 500V more than 10MΩ

## MECHANISM OPERATION

### 1. Overview of the Cassette Drive Mechanism

The cassette drive mechanism consists of two motors and one solenoid. It is based on the same principle as our previous three-motor mechanisms (which employed separate capstan, reel and assist motors) except that one motor is used for both the reel and assist functions. The solenoid is provided to switch between the two functions. As the mechanism is basically identical to our previous three-motor configuration except for the reel/assist switching function, the discussion below will focus on the switching function's main features.

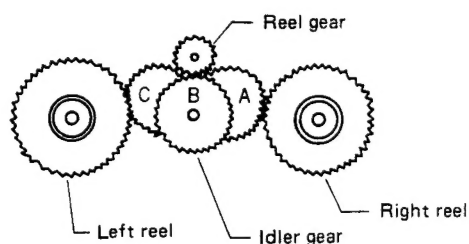


Figure 1: Frontal View of the Assist/Reel Drive Train

In the previous (three-motor) mechanism, the idler gear had two positions: A for fast forward and C for rewind. In the new configuration a third position (B) is added for assist operation.

In the B position, the idler gear is linked to a cam which raises and lowers the heads and rotates them during auto-reverse play. To keep the gear firmly in position, a notched lever presses up against the gear shaft from below. The gear shaft rests in the notch in the lever, maintaining the idler gear in the B position. This arrangement makes it possible to use a single motor for both the reel and assist functions.

Attraction from the solenoid is used to switch from the assist position (position B in figure 1 above) to either the rewind or fast forward position for reel operation. Attractive force from the solenoid is applied to the notched lever, pulling it downward. This disengages the gear shaft from the notch and frees the gear. Then, by applying voltage to the motor, the idler gear can be moved to either the A or C position for reel operation. The notched lever also acts a brake for the reels when solenoidal attraction is applied.

In order to switch back from reel to assist operation, the polarity of the voltage being applied to the motor is reversed. This causes the gear to jerk in the direction of the opposite reel. When it comes to point B, however, the gear shaft catches in the notch in the lever, holding the gear in position for assist operation. This design ensures that the idler gear always switches initially to the assist position before switching to another operation. This also guarantees that the mechanism will be in the correct position after all operations are completed.

The assist/reel motor uses three different voltages to perform the operations described above. The approximate voltages are as follows: 8V for assist operations; 6V for high-speed fast forward and reverse; and 3.5V for recording and playback. They are controlled by the TRQ1 and TRQ2 signals from the microprocessor. In assist operation, the idler gear turns clockwise (viewed from the front) during forward play and counterclockwise during reverse play.

### 2. Mechanism Drive System

The waveforms which drive the mechanism look rather complicated on an oscilloscope. If we break them down into the basic patterns which indicate separate operations, however, and display the combined result in tabular form, table 1 is the result. When the operations listed under "Mechanism Operations" are performed in the order specified (i.e. left to right), the operation "modules" listed under "Drive Sequence" are activated in the order shown (left to right). Figure 2 through 8 below illustrate the waveforms for the various modules.

Note: The polarity of the waveforms differs depending on the direction of tape travel and the type of operation. All durations are given in milliseconds [ms].

Mechanism Operations	Drive Sequence
PLAY → STOP	A → E → G
SEARCH → STOP	C → B → A
FF/REW → STOP	C → G
STOP → PLAY	A → D <sub>2</sub>
PLAY → SEARCH	A → D <sub>1</sub>
STOP → FF/REW	D <sub>1</sub>

Table 1: Drive Sequences for Representative Operations

#### ■ Drive waveform for assist operation

A: While searching for target position

B: The motor reverses to absorb inertia for 30 ms when the heads are being raised and 70 when the heads are being lowered.

Note: The 5 ms gap between A and B is needed in order to move the tape to the center of the target area. The 50 ms period following B is for resetting the mechanism position. Assist operation is performed again if the position is not correct. In this case (only), B is 10 ms in duration. The (■) mark indicates the mechanism position double-check point.

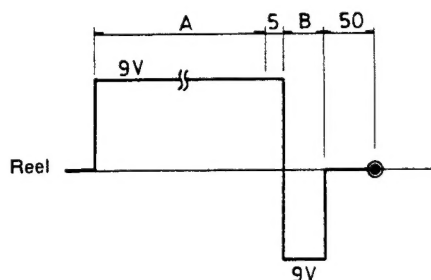


Figure 2: Module A

#### ■ Drive waveform 1 for changing position of idler gear

If the capstan motor is turning when the reel drive signal is received, it is shut off.

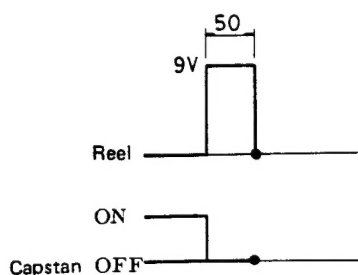


Figure 3: Module B

#### ■ Drive waveform for brake

Attraction from the solenoid engages the brake. The final 10 ms gap is the pause before the next operation starts.

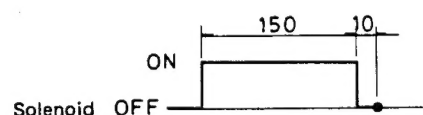


Figure 4: Module C

#### ■ Reel drive waveform

(Used during fast forward, reverse and music search)

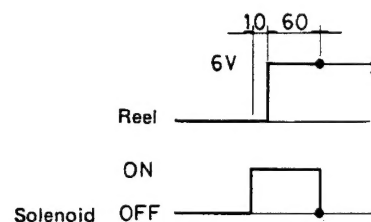


Figure 5: Module D1

#### ■ Reel drive waveform

(Used during record and playback)

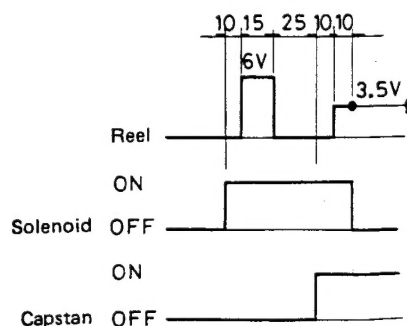


Figure 6: Module D2

### ■ Waveform for taking up tape slack

The reel drive voltage normally consists of 15 pulses (3.5V: on 5 ms, off 2 ms). The number of pulses is increased to 25 during double-speed operation.

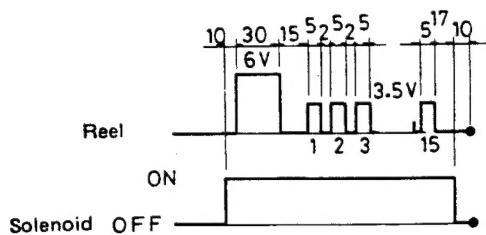


Figure 7: Module E

### ■ Drive waveform 2 for changing position of idler gear

The movement produced is the same as in module B. However, after the first 50 ms peak, the position of the mechanism is checked. If it is not in the stop position, module A is executed. The duration of assist reverse rotation is 10 ms in this case. The (■) mark indicates the mechanism position double-check point.

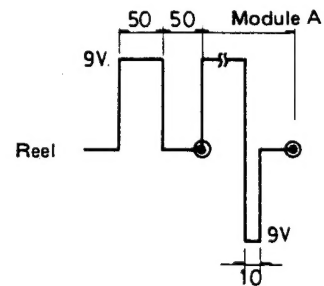


Figure 8: Module G

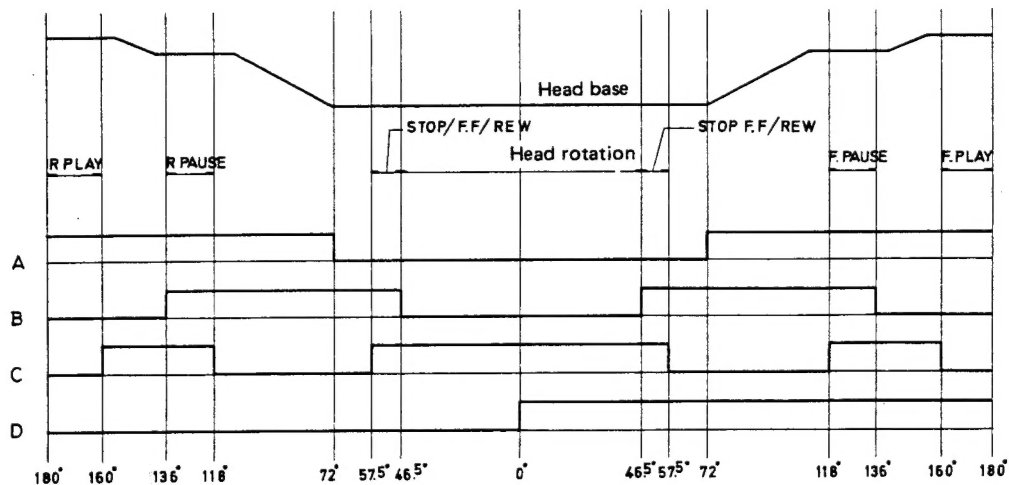
### 3. Initialization of the Mechanism

When power is initially turned on, there is no guarantee that the idler gear is in the assist position. Therefore, signals are issued to move the idler gear first to the left and then to the right, and the gear is secured in position B as shown in figure 1 above. Then modules A, E and G are

executed in succession to put the mechanism in the stop position.

Note: In this particular case, the number of pulses in module E is 25 (the same as during double-speed operation).

### 4. Mechanism Positioning Data



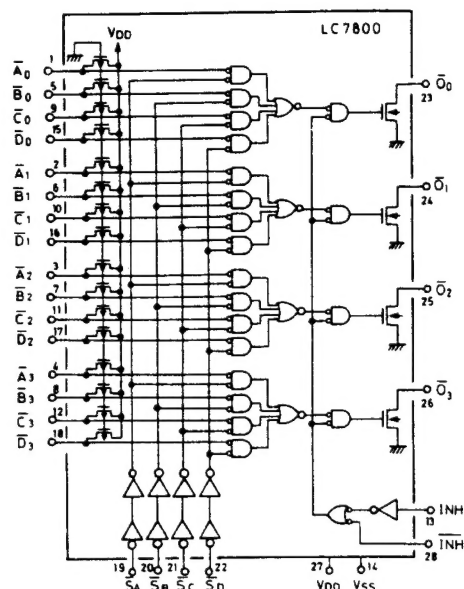
Note: The dotted lines in the positioning data indicate either "0V" or "switch on".

Figure 9: Mechanism Positions and Positioning Data



### 5. Microprocessor and Input Expander

Two input expanders (LC7800) are used to expend the number of inputs to the microprocessor. These ICs each have four 4-bit input ports (A0-3, B0-3, C0-3, D0-3). Four designation input signals are used to specify input ports:  $\overline{SA}$ ,  $\overline{SB}$ ,  $\overline{SC}$ ,  $\overline{SD}$ . If one of the input signals is set to 0 logic, the input port designated by that signal is selected and that input signal is transferred to the output port (O0 – O3).  $\overline{INH}$  and  $\overline{1NH}$  signals are used to differentiate expanders 1 and 2.

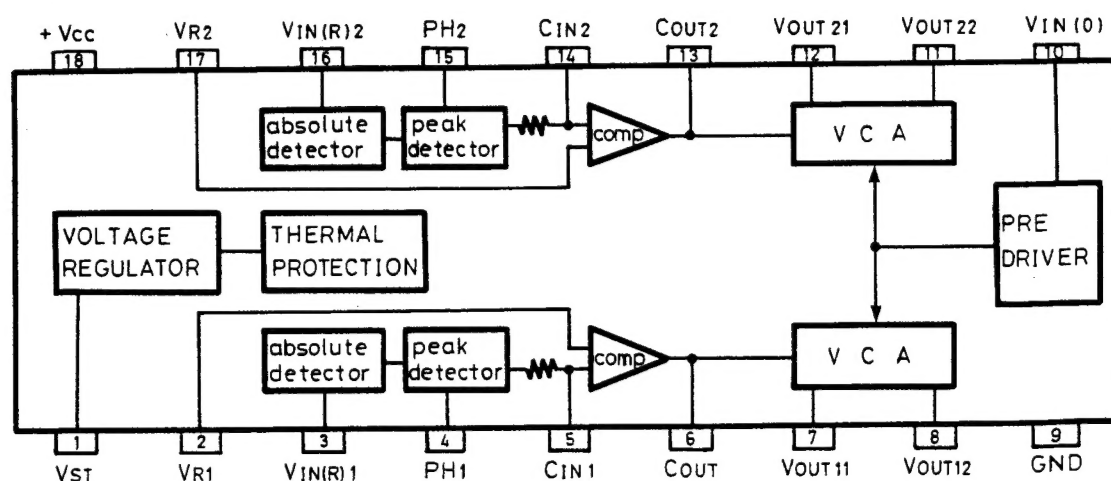


LC7800 equivalent circuit

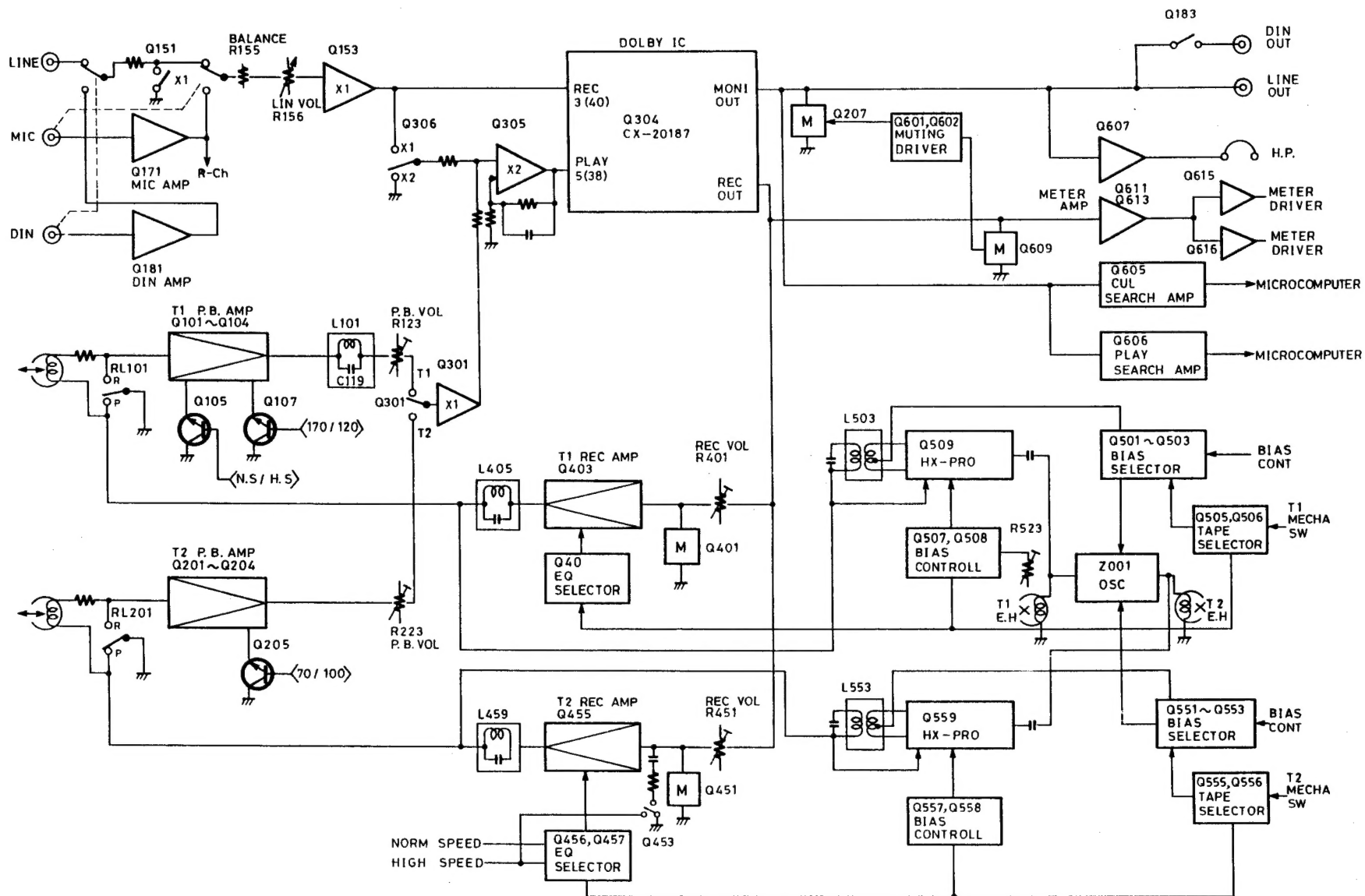
### $\mu$ PC1297CA (DOLBY HX PRO SYSTEM)

When the HX PRO is operation, by means of the recording signal coming from the recording head, a modulating oscillator voltage is applied to the absolute value detection circuit, and by means of the recording signal level peak detection value, the bias current is instantaneously controlled. At such time, by means of the CR integrated circuit, the frequency characteristic is maintained.

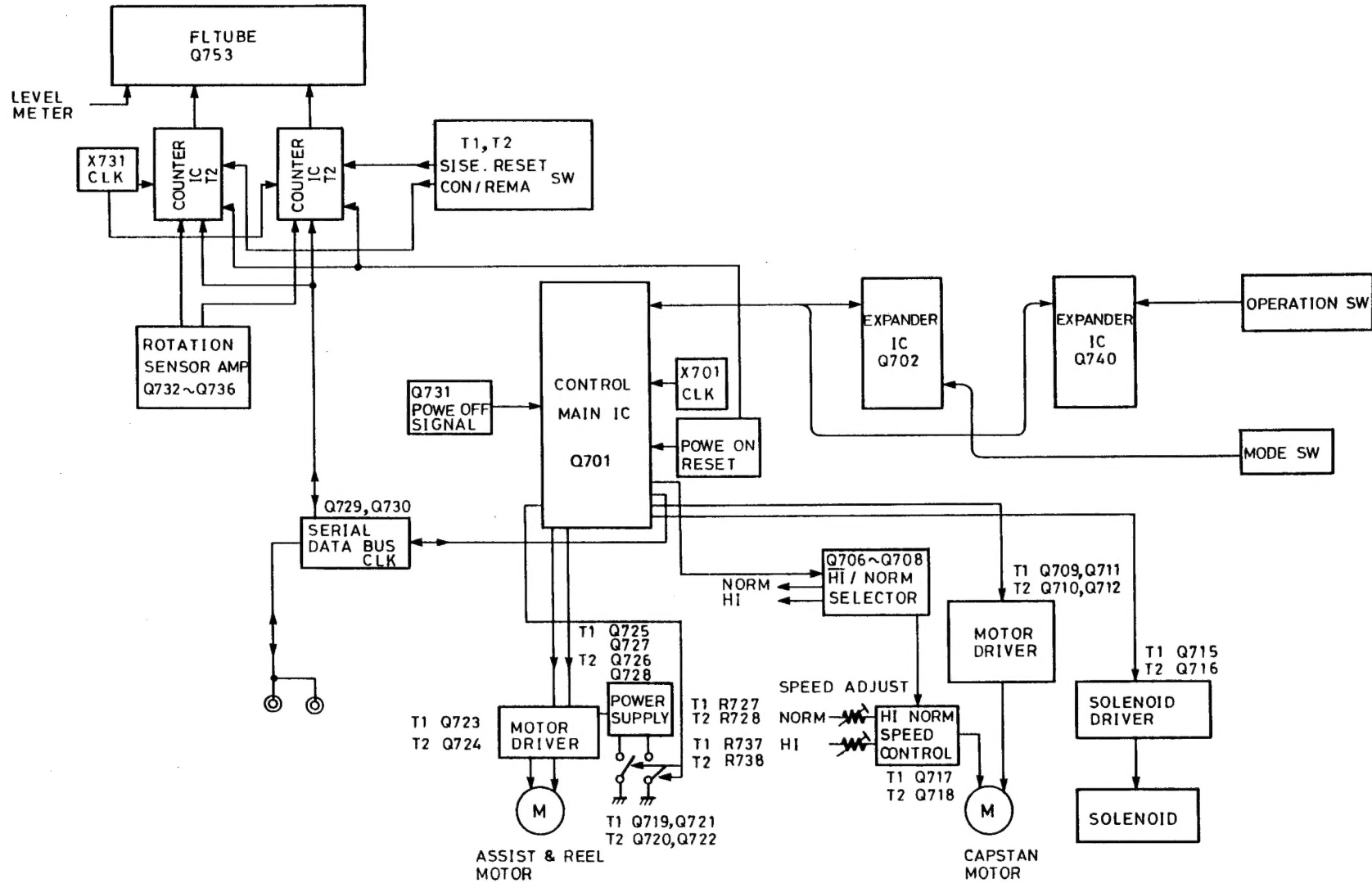
### $\mu$ PC1297CA



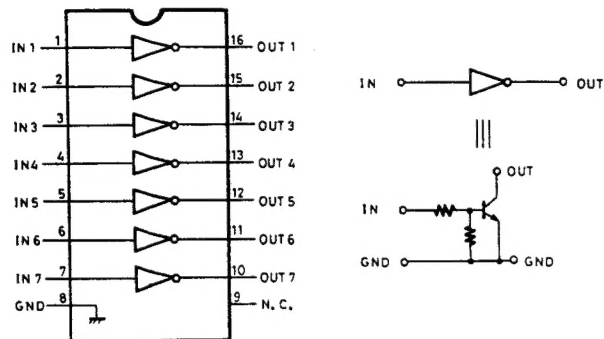
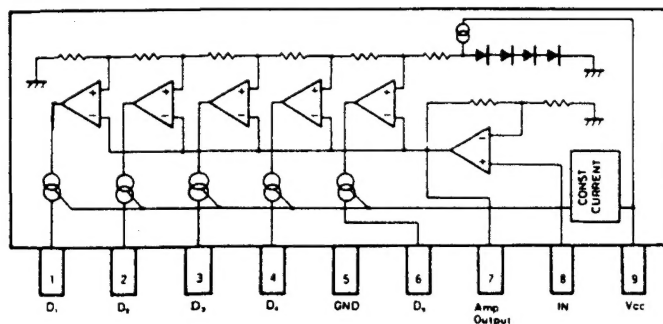
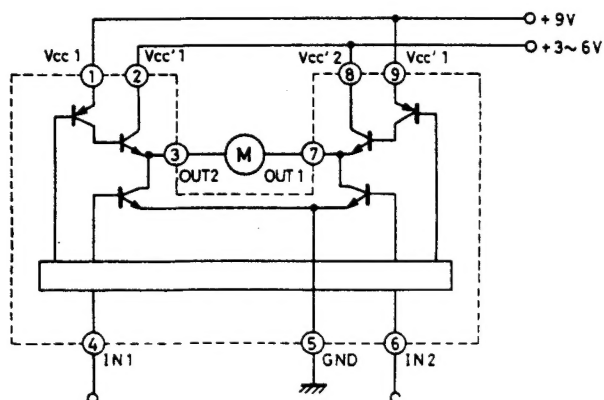
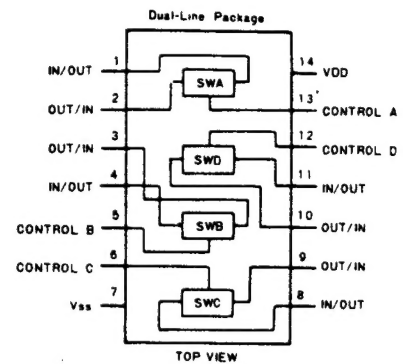
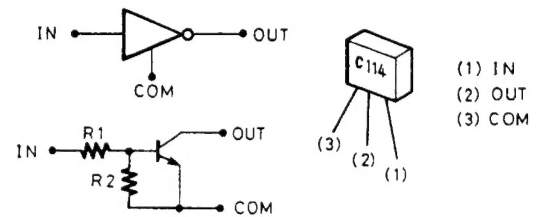
# BLOCK DIAGRAM (AUDIO SECTION)



# BLOCK DIAGRAM (CONTROL SECTION)



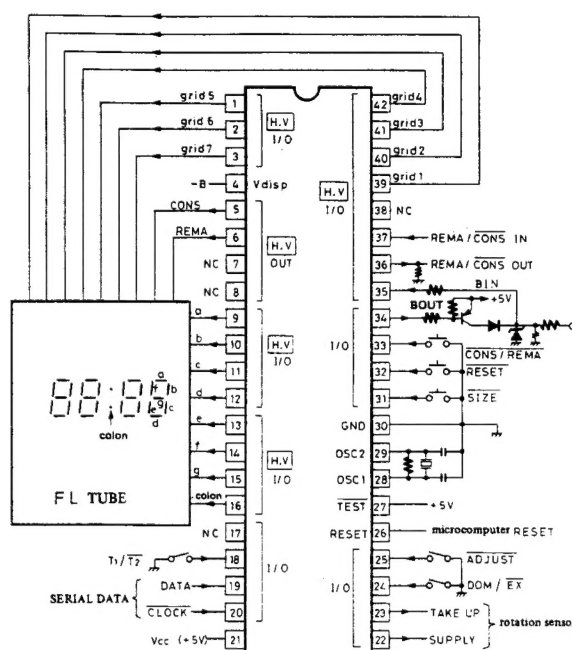
# IC BLOCK DIAGRAM

**BA6251 (REC AMP. EQ. SW)**

**BA6137 (METER AMP)**

**M54544AL (MOTOR DRIVE)**

**4066B or BU4066BP**

**DTC144ES  
DTC114YS (Digital transistor)**


	R 1	R 2
DTC 114 YS	10 K $\Omega$	47 K $\Omega$
DTC 144 ES	47 K $\Omega$	47 K $\Omega$

INPUT		OUTPUT		Remark
# 4	# 6	# 3	# 7	
L	L	OFF	OFF	—
H	L	H	L	FWD
L	H	L	H	REV
H	H	L	L	Brake

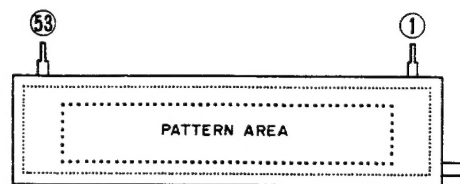
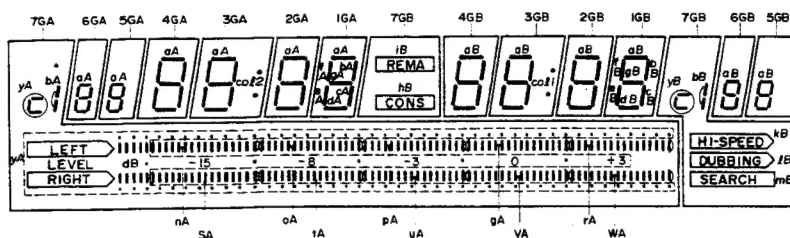
## HD614128S-A41 (COUNTER)



## Terminal Name and Function

Pin No.	Name	Function
1 ~ 3	Grid 5 ~ 7	FL tube grid (DIGIT) drive use output
4	V <sub>disp</sub>	Input (FL tube use) for minus bias voltage to pin Nos. 1 ~ 3, 5, 6, 9 ~ 16, 39 ~ 42
5	CONS	FL tube <b>CONS</b> display use output (time lapse)
6	REMA	FL tube <b>REMA</b> display use output (time remaining)
9 ~ 15	a ~ g	FL tube segment drive use output
16	Colon	FL tube ":" drive use output
18	T <sub>1</sub> /T <sub>2</sub>	Microcomputer T <sub>1</sub> /T <sub>2</sub> function selection input (With T <sub>2</sub> , system I/O receiving)
19	DATA	Reck mechanism status input (8 bit serial data) from mechanism control micro-computer
20	CLOCK	Clock input for reading above DATA (DATA taken on pulse wave dropping)
21	V <sub>cc</sub>	Microcomputer power source (+5V)
22	SUPPLY	Cassette mechanism tape feed side turning pulse input
23	TAKE UP	Cassette mechanism tape windup side turning PULSE INPUT
24	DOM/EX	Domestic/export setting use selector input (Tape size type selector use) Domestic: With power ON C46 → C54 → C60 → C80 → C90 → C120
25	ADJUST	Remaining time calculation buffer compensating value input (normally open, compensating ground)
26	RESET	Microcomputer system reset
27	TEST	Microcomputer internal test use port, normally connected to V <sub>cc</sub>
28, 29	OSC1, OSC2	Microcomputer clock oscillator terminal
30	GND	Microcomputer power source (GND)
31	SIZE	Tape size selector input
32	RESET	Lapsed time reset input (When <b>CONS</b> displays, digits are □ : □ □)
33	CONS/REMA	Lapsed time ↔ remaining time selector input (toggle display)
34	BOUT	System bus output
35	BIN	System bus input
36	REMA/CONS OUT	Remaining time display/lapsed time display status output (when T <sub>2</sub> )
37	REMA/CONS IN	Remaining time display/lapsed time display status input (when T <sub>2</sub> )
39 ~ 42	Grid 1 ~ 4	FL tube grid (DIGIT) drive use output

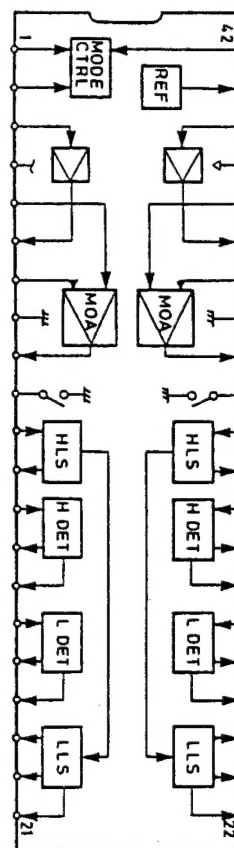
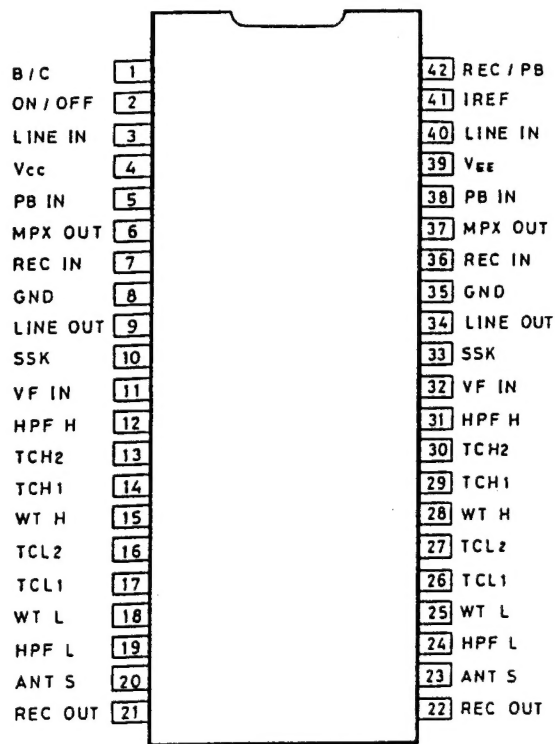
### BG-485G (DISPLAY TUBE)



### PIN CONNECTION

[illegible]

CX20187 (DOLBY N.R)



— II —



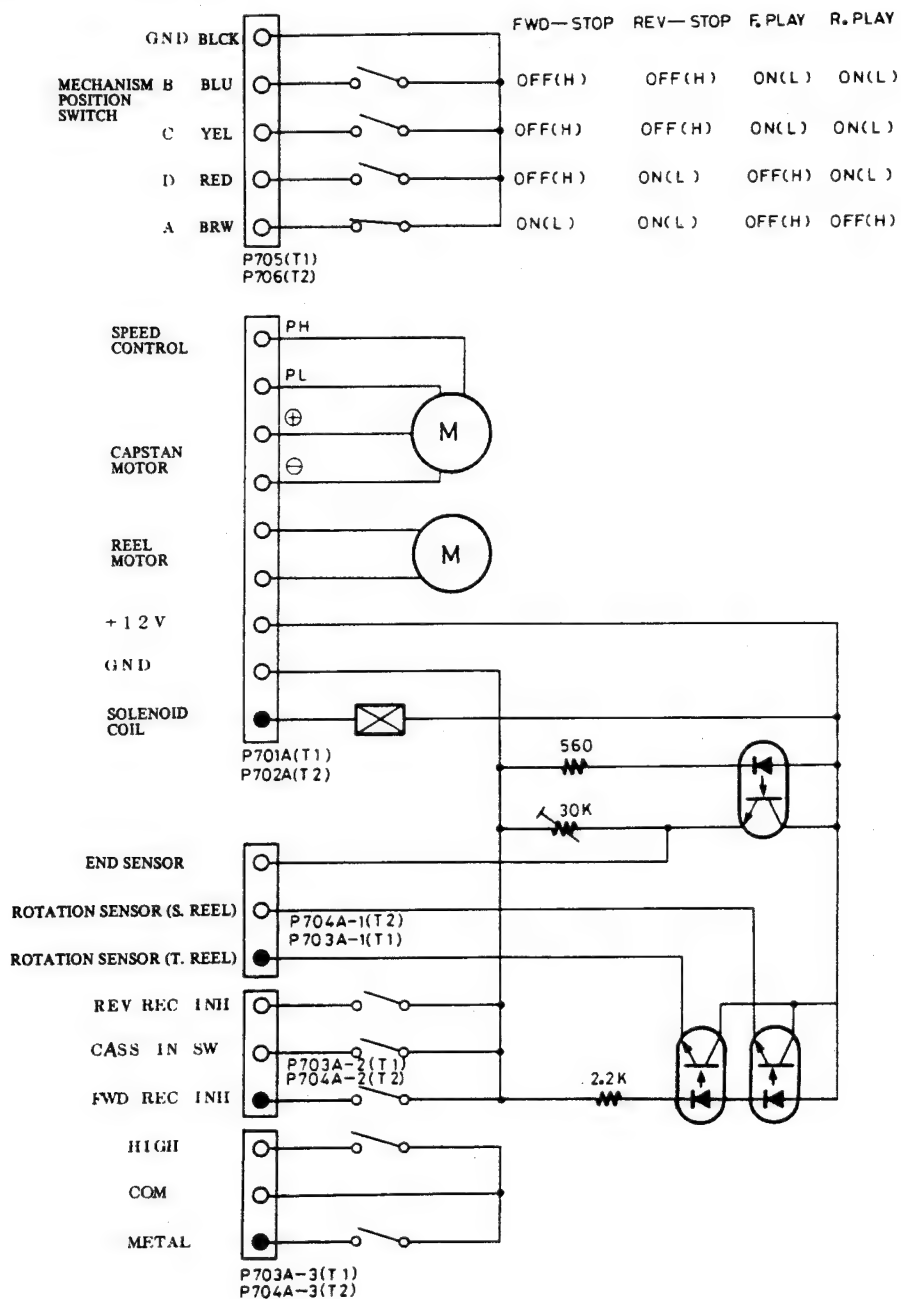
## NAMES AND FUNCTIONS OF MICROCOMPUTER PORTS

Port No.	Name	Function
1	T2 PAUSE	T2 pause display output (permits direct drive of LED or fluorescent display).
2	T2 REV. DIR	T2 reverse direction display output.
3	T2 FWD. DIR	T2 forward direction display output.
4	PRESET	Preset display output for music search.
5	(NOT USED)	Not used; always connected to Vcc.
6	X1 DUBBING	Dubbing display output for fluorescent display.
7	X2 DUBBING	High-speed dubbing display output for fluorescent display.
8	T2 REC. MUTE	T2 rec. muting output.
9	T1 REC. MUTE	T1 rec. muting output.
10	(NOT USED)	Not used.
11	LINE MUTE	Line muting output.
12	T2 REC./P.B	T2 recording/playback head switching output.
13	T1 REC./P.B	T1 recording/playback head switching output.
14	INPUT SEL.	Output for switching the playback signal input. H indicates T1 and L indicates T <sub>2</sub> .
15	X1 DUBBING	This output is H for normal speed dubbing and L at all other times.
16	DOLBY NR OFF	Output to turn Dolby NR off.
17	P-OFF	Input signal indicating that power has been detected; halts mechanism.
18	T2 OPTICAL END SENSOR	T2 tape-end input triggered when leader tape is detected (negative logic).
19	T1 OPTICAL END SENSOR	T1 tape-end input triggered when leader tape is detected (negative logic).
20	SEARCH SIG.	Signal input from search amplifier used for music search.
21	SEARCH SIG-LOW	Signal input from low-speed amplifier used for single repeat operation.
22	T2 ROTATION SENSOR	T2 head rotation pulse input for end-of-tape detection.
23	T1 ROTATION SENSOR	T1 head rotation pulse input for end-of-tape detection.
24	T2 REV.	Together with the signal from pin #25, this output signal controls the rotational direction of the reel motor.
25	T2 FWD.	Together with the signal from pin #24, this output signal controls the rotational direction of the reel motor.
26	T2 TRQ1	Together with the signal from pin #27, this output signal controls the torque of the reel motor.
27	T2 TRQ2	Together with the signal from pin #26, this output signal controls the torque of the reel motor.
28	T1 REV.	Together with the signal from pin #29, this output signal controls the rotational direction of the reel motor.
29	T1 FWD.	Together with the signal from pin #28, this output signal controls the rotational direction of the reel motor.
30	T1 TRQ1	Together with the signal from pin #31, this output signal controls the torque of the reel motor.
31	T1 TRQ2	Together with the signal from pin #30, this output signal controls the torque of the reel motor.
32	Vcc	Power supply terminal.
33	S-CLK	Clock output signal for sending mechanism status data to the real time counter.
34	SERIAL OUT	NRSC code output.
35	S-DATA	Mechanism status data output signal which is sent to the real time counter.
36	SERIAL IN	NRSC code input.
37	T2 SOL.	Mechanism T2 solenoid drive output (negative logic).
38	T1 SOL.	Mechanism T1 solenoid drive output (negative logic).
39	T2 CAPSTAN	T2 capstan on/off control output.
40	T1 CAPSTAN	T1 capstan on/off control output.
41	CAP. SPEED	Capstan speed control output for both T1 and T2. L selects normal speed; H selects high speed.
42	T2 BIAS	T2 bias oscillator control output. H turns oscillator on.
43	T1 BIAS	T1 bias oscillator control output. H turns oscillator on.
44	EXP. SELECT	Output to specify expander 1 or 2.
45 ~ 48	00 ~ 03	Signal input from expanders.
49	RESET	Microprocessor system reset input.



Port No.	Name	Function
50	TEST	Microprocessor internal check input. H indicates "normal."
51, 52	OSC1, OSC2	Terminal for clock oscillator.
53	GND	Ground terminal.
54 ~ 57	Sd ~ Sa	Expander selector output.
58	T1 REC	T1 record display output (permits direct drive of LED or fluorescent display).
59	T1 PLAY	T1 play display output (permits direct drive of LED or fluorescent display).
60	T1 PAUSE	T1 pause display output (permits direct drive of LED or fluorescent display).
61	T1 REV. DIR	T1 reverse direction display output (permits direct drive of LED or fluorescent display).
62	T1 FWD. DIR	T2 forward direction display output (permits direct drive of LED or fluorescent display).
63	T2 REC	T2 record display output (permits direct drive of LED or fluorescent display).
64	T2 PLAY	T2 play display output (permits direct drive of LED or fluorescent display).

## TAPE MECHANISM CONNECTION



## ADJUSTMENT PROCEDURES

### PRECAUTIONS

- Before adjustment, clean the following parts with an alcohol moistened swab.
  - \* record/playback head
  - \* pinch roller
  - \* erase head
  - \* capstan
- Do not use magnetized screwdriver for adjustments.
- Demagnetize record/playback head with a head demagnetizer.

### TEST EQUIPMENT/TOOLS REQUIRED:

Audio oscillator  
 Digital frequency counter  
 Oscilloscope  
 Attenuator  
 AC voltmeter  
 Non-magnetic screw driver  
 Test tapes  
   VTT-658 : 10 KHz, -15dB  
   MTT-111 : 3 kHz, -10dB  
   MTT-150 : Dolby level calibration  
           400Hz, tone 200nWb/m

Item		Connection of instrument	Line input	Test tape	Mode	Output indicator	Adjustment point	Adjust	Remarks
1	Tape speed	Frequency counter to LINE output terminal		MTT-111	PB	Frequency counter	T1 Normal R727 T1 High R737 T2 Normal R728 T2 High R738	3010 ± 5Hz 6020 ± 10Hz 3010 ± 5Hz 6020 ± 10Hz	High speed connect the TP-7 to GND
2	Head azimuth	AC voltmeter and oscilloscope to LINE output terminal		VTT-658	PB	AC voltmeter	Head azimuth screw	Maximum and same phase at channels L and R	fig. 1
3	Playback level	AC voltmeter to terminals TP-1 and TP-2		MTT-150	PB	AC voltmeter	T1 R123 (Ch.L) T1 R124 (Ch.R) T2 R223 (Ch.L) T2 R224 (Ch.R)	245mV	
4	OSC Block	AC voltmeter to R507 (T1) and R557 (T2)		T1, T2 METAL TAPE MX-C60	T1, T2 REC	AC voltmeter	Z001 T1 Coil T2 Coil	Maximum	
5	HX-PRO	AC voltmeter to terminals TP-1, TP-2, TP-3 and TP-4		T1, T2 METAL TAPE MX-C60	T1, T2 REC	AC voltmeter	T1 L503 (Ch.L) T1 L504 (Ch.R) T2 L553 (Ch.L) T2 L554 (Ch.R)	Maximum	Bias VR R523, R524 R573, R574 maximum
6	Bias current	fig. 2	1kHz, -20dB and 12kHz, -20dB	XL-II C-90	REC/PB	AC voltmeter	T1 R523 (Ch.L) T1 R524 (Ch.R) T2 R573 (Ch.L) T2 R574 (Ch.R)	Same level at REC/PB	Input VR maximum
7	Record level	fig. 2	1kHz	XL-II C-90	REC	AC voltmeter	Attenuator or AF OSC output	350mV	
					REC/PB	AC voltmeter	T1 R401 (Ch.L) T1 R402 (Ch.R) T2 R451 (Ch.L) T2 R452 (Ch.R)	Same level at REC/PB	
8	Reverse operation sensitivity	DC voltmeter to sockets P703-1 (T1) #1 P704-1 (T2) #1		TDK AD-120 Magnetic substance	FWD PB	DC voltmeter	Semi-fixed VR (T-1, T-2) on the mechanism P.C.B.	2 ~ 2.5V	

### Blank tape

NORMAL ----- UD-1 C-90  
 HIGH ----- XL-II C-90  
 METAL ----- MX C-90

PLAY torque ----- 30 ~ 60 g/cm  
 FF. REW torque ----- 70 ~ 140 g/cm  
 Back tension ----- 2 ~ 5 g/cm

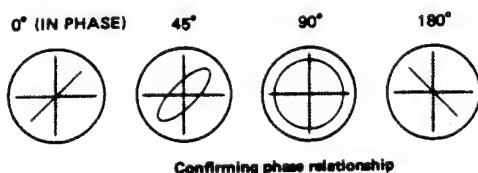
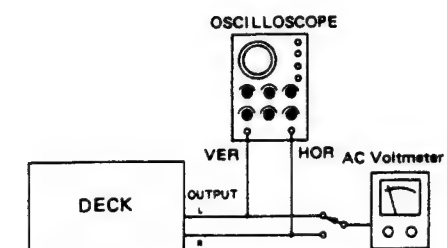
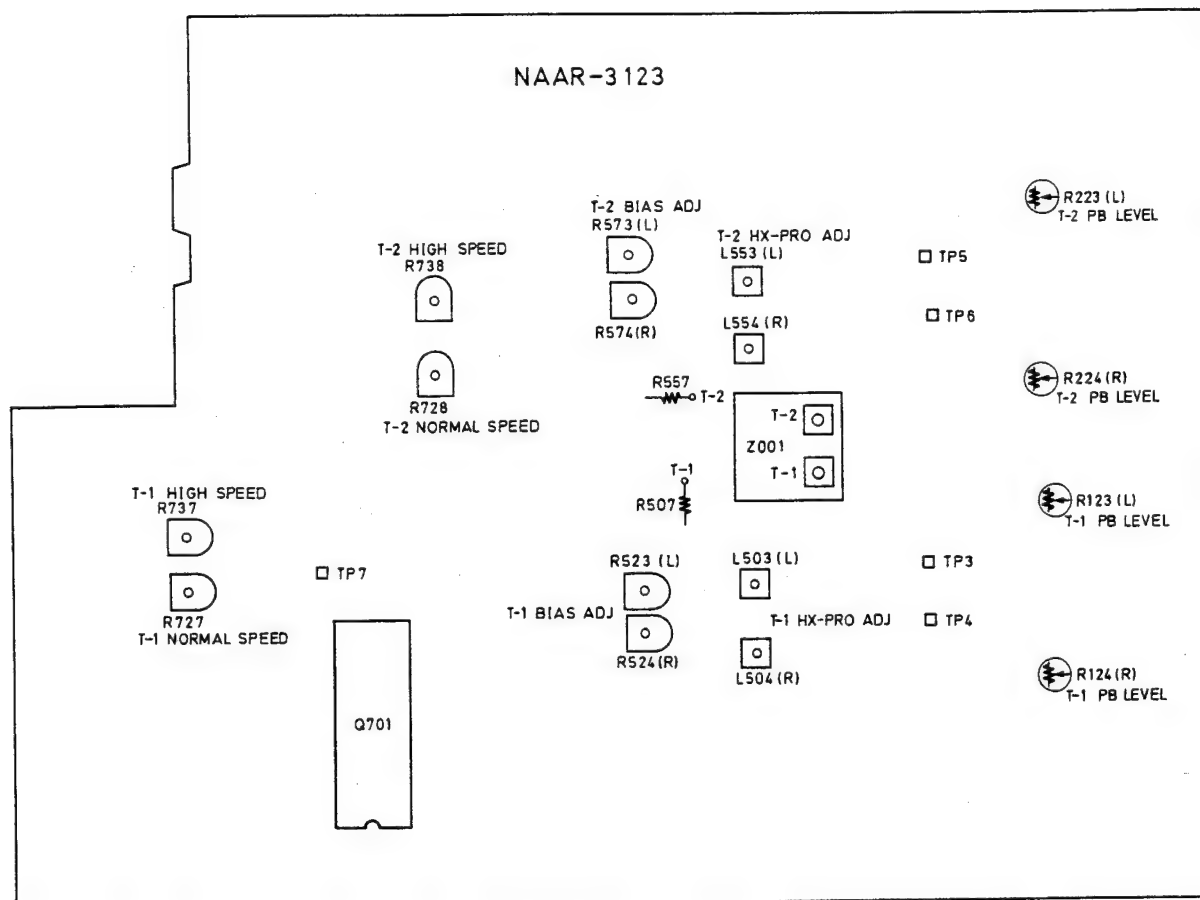


fig-1

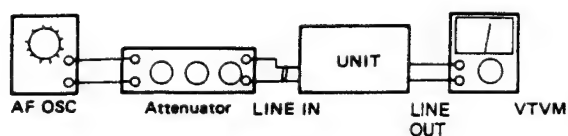
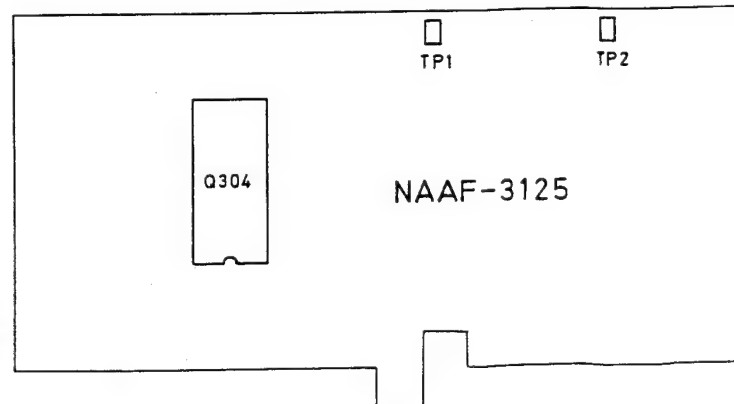
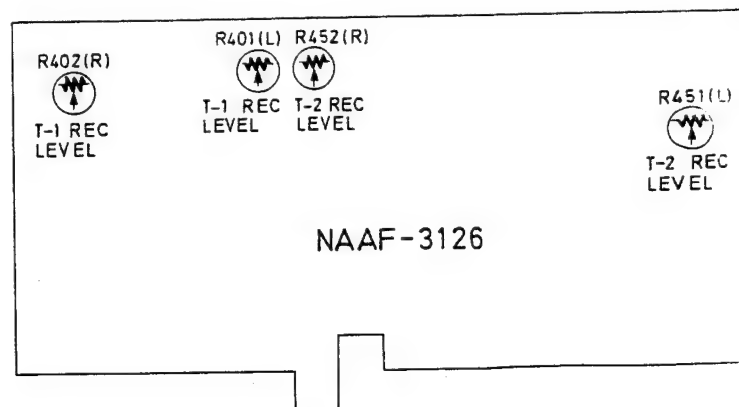


fig-2



## CHASSIS EXPLODED VIEW PART LIST

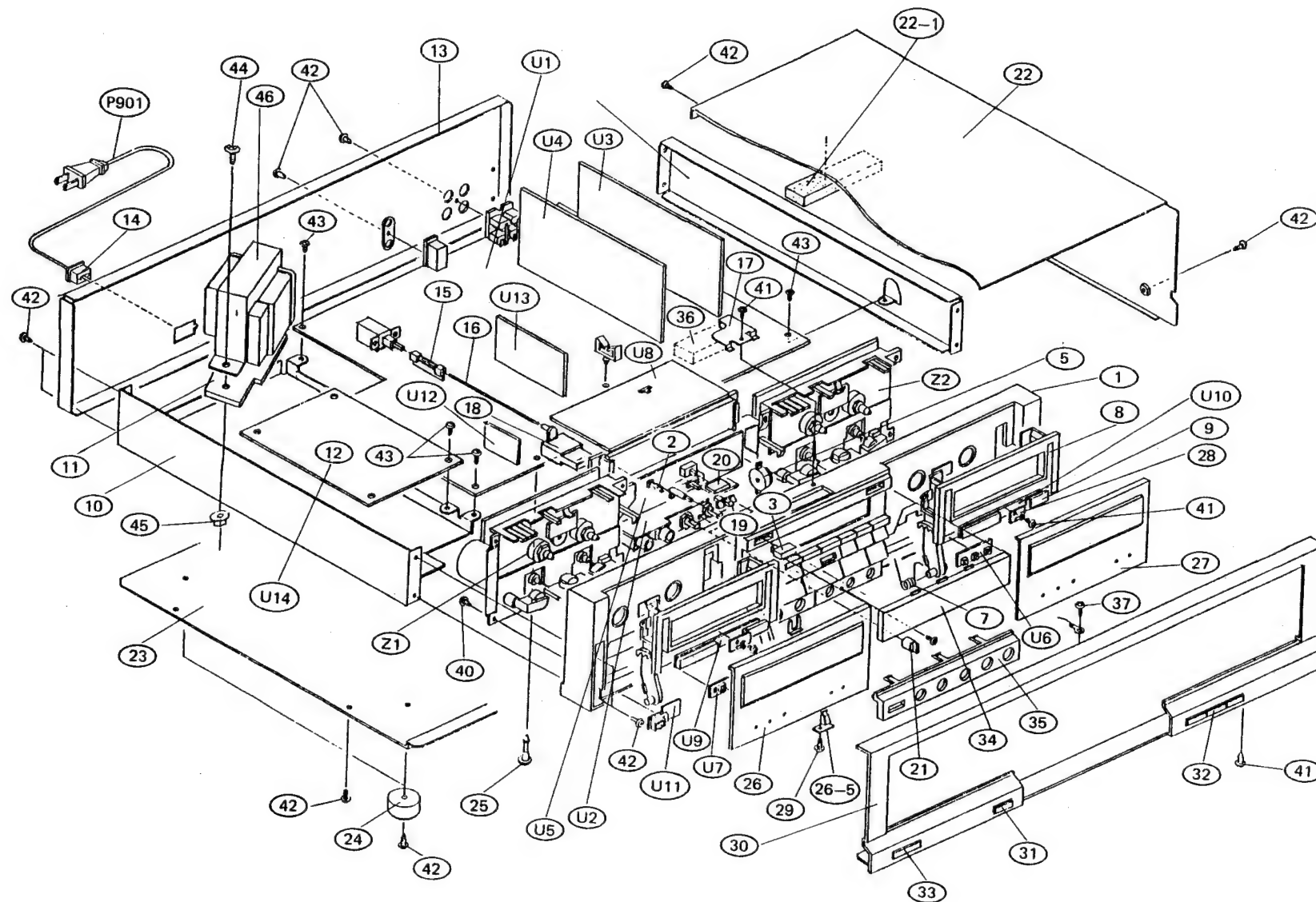
REF.NO.	PART NO.	DESCRIPTION
1	27110378	FRONT BRACKET AS
2	27273082	JOINT (EJECT)
3	28323149	KNOB (EJECT) L
4	28323150	KNOB (EJECT) R
5	28400282	DAMPER
6	27180314	SPRING (T1)
7	27180315	SPRING (T2)
8	28400339	FRAME AS (CASSETTE)
8-1	28400340	FRAME (CASSETTE)
8-2	27180272	SPRING (CA)
9	27190563	HOLDER (LED-5)
10	27130500	BRACKET (PT)
11	27270214A	SPACER
12	27115194-1	SIDE BRACKET
13	27121048	BACK PANEL (D)
	27121049	BACK PANEL (G)
	27121051	BACK PANEL (W)
14	27300750	BUSHING (CORD)
15	27273084	JOINT (POW)
16	27260084	SHAFT
17	27141158	BRACKET (FL)
18	28323151	KNOB (POW)
19	28323152	KNOB (MODE)
20	28323153	KNOB (RPT)
21	28323163	KNOB (DOLBY)
22	28184373	TOP COVER
22-1	28140798	CUSHION
23	27170243	BOTTOM BOARD
24	27175009A	LEG (S)
25	27190524	HOLDER
26	28400341A	CASSETTE LID AS (T1)
26-1	28400342	CASSETTE LID
26-2	28400343A	WINDOW (T1)
26-3	28400345	CASSETTE LID (T1)
26-4	28198688	FACET (DIR)
26-5	27180362	SPRING
27	28400344A	CASSETTE LID AS (T2)
27-1	28400342	CASSETTE LID
27-2	28400352A	WINDOW (T2)
27-3	28400345	CASSETTE LID (T1)
27-4	28198688	FACET (DIR)
27-5	27180362	SPRING
28	27141159	BRACKET
29	834230108	3TTS+10B(Ni)
30	1N027121A	FRONT PANEL

REF.NO.	PART NO.	DESCRIPTION
31	28323154	KNOB AS (AUTO)
32	28323156	KNOB AS (DUB)
33	28198689	FACET (HX)
34	28191437A	CLEAR PLATE
35	28400347	COSMETIC PLATE
36	28140805	CUSHION
37	834230088	3TTS+8B(Ni)
40	381430100	TAP-TIGHT SCREW 3TTW+10PBC
41	833430088	TAP-TIGHT SCREW 3TTP+8PBC
42	834430088	TAP-TIGHT SCREW 3TTS+8BBC
43	831130088	TAP-TIGHT SCREW 3TTW+8B
44	838440129	TAP-TIGHT SCREW 4TTB+12CBC
45	86414010	NUT FWN4+10FN
△ 46	2300265A	NPT-976D,POWER TRANSFORMER (D)
	2300266A	NPT-976G,POWER TRANSFORMER (G)
	2300267A	NPT-976DG,POWER TRANSFORMER (W)
	2300274A	NPT-976Q,POWER TRANSFORMER (Q)
△ P901	253112A	AS-UC-4,POWER SUPPLY CORD (D)
	253128B	AS-CEE,POWER SUPPLY CORD (G/W)
	253118	AS-SAA,POWER SUPPLY CORD (Q)
△ S902	25065123	NSS-1258P,VOLTAGE SELECTOR SWITCH (W)
Z1	244109A	CASSETTE DECK MECHANISM
Z2	244110A	CASSETTE DECK MECHANISM
U1	1N027523-1	NAAR-3123-1,MAIN PC BOARD ASS'Y (D)
	1N027523-1A	NAAR-3123-1A,MAIN PC BOARD ASS'Y (G/W)
U2	1N027524-1	NAAF-3124-1,MIC.VR.PC BOARD ASS'Y
U3	1N027525-1	NAAF-3125-1,DOLBY NR PC BOARD ASS'Y
U4	1N027526-1	NAAF-3126-1,REC AMP PC BOARD ASS'Y
U5	1N027527-1	NASW-3127-1
U6	1N027528-1	NASW-3128-1
U7	1N027536-1	NASW-3136-1
U8	1N027529-1	NADIS-3129-1,DISPLAY PC BOARD ASS'Y
U9	1N027530-1	NADIS-3130-1,TAPE-1 LED PC BOARD ASS'Y
U10	1N027531-1	NADIS-3131-1,TAPE-2 LED PC BOARD ASS'Y
U11	1N027532-1	NADIS-3132-1
U12	1N027533-1	NADG-3133-1,INPUT EXPANSION PC BOARD ASS'Y
U13	1N027534-1	NAETC-3134-1,SENSOR PC BOARD ASS'Y
U14	1N027535-1	NAETC-3135-1,POWER SUPPLY PC BOARD ASS'Y

**NOTE: THE COMPONENTS IDENTIFIED BY MARK △ ARE CRITICAL FOR RISK OF FIRE AND ELECTRIC SHOCK. REPLACE ONLY WITH PART NUMBER SPECIFIED.**

**NOTE:** (D): Only 120V model  
(G): Only 220V model  
(W): Only Universal model  
(Q): Only 240V model

# CHASSIS EXPLODED VIEW



## PRINTED CIRCUIT BOARD PART LIST

NAAR-3123-1 CIRCUIT NO.	PART NO.	DESCRIPTION	CIRCUIT NO.	PART NO.	DESCRIPTION
	ICs				
Q181	222917	NJM-4558S-D (G/W)	Q713,Q714	2213090	DTA114YS
Q509,Q559	222959	$\mu$ PC1297CA	Q715,Q716	2213170	2SD1809
Q605	222465	NJM-4558D	Q717,Q718	2212304 or	2SK381-D or
Q606	222681 or	IR-3702 or	Q719,Q720	2211945	2SK246GR
	222695	LA-6324	Q721,Q722	221282	DTC144ES
Q607	222652	M5218L	Q725,Q726	221282	DTC144ES
Q701	22240089	HD-614088S-B53		2211255 or	2SC1815GR or
Q702	222810	LC-7800	Q727,Q728	2210746	2SC945-A-P
Q723,Q724	222953	M-54544AL		2201285 or	2SD882-Q or
				2201286	2SD882-P
	Transistors		Q729,Q731	2211455 or	2SA1015-GR or
Q101-Q104	2211896 or	2SC1815LL or	Q730	2212495	JA101Q
	2211406	2SC2240-BL		2211255 or	2SC1815GR or
Q105-Q108	2211255 or	2SC1815GR or		2210746	2SC945-A-P
	2210746	2SC945-A-P			
Q151,Q152	2212794 or	2SD1468-R or	D101	Diodes	
	2212795	2SD1468-S	D104	223163	1SS133
Q183,Q184	2212304 or	2SK381-D or (G/W)		223150,	US1040, (G/W)
	2211945	2SK246-GR		223124 or	1S2473 or
Q185	221281	DTC114YS (G/W)	D105,D106	223145	1S2076TD
Q201-Q204	2211896 or	2SC1815LL or	D501	223163	1SS133 (G/W)
	2211406	2SC2240-BL	D502	223163	1SS133
Q205,Q206	2211255 or	2SC1815GR or		2243253,	MTZ-15C,
	2210746	2SC945-A-P		2239673 or	RD15E-B3 or
Q207,Q208	2212794 or	2SD1468-R or	D503	224651503	HZ-15E-B3
	2212795	2SD1468-S		223150,	US1040,
Q501	2211455 or	2SA1015-GR or		223124 or	1S2743 or
	2212495	JA101Q	D504,D505	223145	1S2076TD
Q502	2201540	2SD947	D509	223163	1SS133
Q503	221281	DTC114YS	D551	223163	1SS133
Q504-Q506	2211455 or	2SA1015-GR or	D552	2243253,	MTZ-15C,
	2212495	JA101Q		2239673 or	RD15E-B3 or
Q507,Q508	221281	DTC114YS		224651503	HZ-15E-B3
Q551	2211455 or	2SA1015-GR or	D553,D554	223163	1SS133
	2212495	JA101Q	D555-D559	223150,	US1040,
Q552	2201540	2SD947		223124 or	1S2473 or
Q553	221281	DTC114YS		223145	1S2076TD
Q554-Q556	2211455 or	2SA1015-GR or	D601	223163	1SS133
	2212495	JA101Q	D602-D604	223150,	US1040,
Q557,Q558	221281	DTC114YS		223124 or	1S2473 or
Q601	221281	DTC114YS		223145	1S2076TD
Q602	2211455 or	2SA1015-GR or	D605	2243152	MTZ-5.6B
	2212495	JA101Q		2239472 or	RD5.6E-B2 or
Q603,Q604	221281	DTC114YS		224650562	HZ-5.6E-B2
Q609,Q610	2211255 or	2SC1815GR or	D606,D607	223163	1SS133
	2210746	2SC945-A-P	D608,D609	223163	1SS133
Q703	2211455 or	2SA1015-GR or	D701	223163	1SS133
	2212495	JA101Q	D703,D704	223150,	US1040,
Q704,Q705	221281	DTC114YS		223124 or	1S2473 or
Q706	221282	DTC144ES		223145	1S2076TD
Q707	2213090	DTA114YS	D705-D707	223163	1SS133
Q708,Q709	221281	DTC114YS	D708	2243151,	MTZ-5.6A,
Q710	221281	DTC114YS		2239471 or	RD5.6E-B1 or
Q711,Q712	2212853,	2SB1068-K,		224650561	HZ-5.6E-B1
	2212855,	2SB1068-U,	D709,D710	223150,	US1040,
	2212845 or	2SB598-E or		223124 or	1S2473 or
	2212846	2SB598-F	D912	223145	1S2076TD
				2241291 or	RD3.3EB1 or
				224650331	HZ-3.3E-B1

# PRINTED CIRCUIT BOARD PART LIST

CIRCUIT NO.	PART NO.	DESCRIPTION	CIRCUIT NO.	PART NO.	DESCRIPTION
	Coils				
L101,L102	231091	NCH-2139	R737,R738	5215044	N08HR 5KBC
L501,L502	231077 or	NCH-2125 or	R739,R740	4000115	LT3600 1/4S 1.8K
	231025	NCH-1064	R767	49163392404	3.9k × 4,1/10W,NETWORK
L503,L504	231127	NCH-4183	R768	49163392412	3.9k × 12,1/10W,NETWORK
L551	231077 or	NCH-2125 or		Plugs	
	231025	NCH-1064	P101	25055102	NPLG-5P86
L553,L554	231127	NCH-4183	P105-P107	25055133	NPLG-3P117
Z001	231113	NOB-037	P201	25055102	NPLG-5P86
X701	3010118	CSA-3.00MG	P301	25055065	NPLG-5P51
	Capacitors		P302	25055047	NPLG-12P35
C105,C106	392880337T	3.3 $\mu$ F50V,LL	P401	25055066	NPLG-7P52
C111,C112	354741009T	10 $\mu$ F16V,ELECT.	P402	25055067	NPLG-9P53
C113,C114	354742209T	22 $\mu$ F16V,ELECT.	P501,P551	25055100	NPLG-3P84
C123,C124	354744709T	47 $\mu$ F16V,ELECT.	P601	25055148	NPLG-4P132
C181,C182	354741009T	10 $\mu$ F16V,ELECT. (G/W)	P602,P604	25055133	NPLG-3P117
C185,C186	354780229T	2.2 $\mu$ F50V,ELECT. (G/W)	P705,P706	25055135	NPLG-5P119
C187,C188	354741009T	10 $\mu$ F16V,ELECT. (G/W)	P707	25055149	NPLG-5P133
C203,C204	392880337T	3.3 $\mu$ F50V,LL	P709	25055147	NPLG-3P131
C209,C210	354741009T	10 $\mu$ F16V,ELECT.	P710,P711	25055187	NPLG-6P171
C211,C212	354742209T	22 $\mu$ F16V,ELECT.	P712	25055183	NPLG-2P167
C217,C218	354744709T	47 $\mu$ F16V,ELECT.	P713	25055258	NPLG-6P241
C501,C502	354744709T	47 $\mu$ F16V,ELECT.	P714,P716	25055183	NPLG-2P167
C505	354780479T	4.7 $\mu$ F50V,ELECT.	P723	25045172	HSJ-1003-01-020
C506	354722219S	220 $\mu$ F 6.3V,ELECT.	P724	25055146	NPLG-2P130
C509,C510	370131814	180PF 100V,APS		Socket	
C511,C512	370131014	100PF 100V,APS	P104	25050064	NSCT-5P18,DIN (G/W)
C521,C522	354741009T	10 $\mu$ F16V,ELECT.	P701A	2000759	NSAS-18P715
C551	354744709T	47 $\mu$ F16V,ELECT.	P702A	2000740	NSAS-18P696
C552	354780479T	4.7 $\mu$ F50V,ELECT.	P703A	2000761	NSAS-18P717
C556	354722219T	220 $\mu$ F 6.3V,ELECT.	P704A	2000762	NSAS-18P718
C559,C560	370131814	180PF 100V,APS	P911A	2000760A	NSAS-12P716
C561,C562	370131014	100PF 100V,APS	P912A	2000398	NSAS-12P357
C571,C572	354741009T	10 $\mu$ F16V,ELECT.		Relay	
C573,C574	354742209T	22 $\mu$ F16V,ELECT.	RL101,RL201	25065174	NRL2P1A-DC12-09
C601,C603	354780479T	4.7 $\mu$ F50V,ELECT.		Switch	
C602	354744709T	47 $\mu$ F16V,ELECT.	P901	25035559	NPS-111L521P,PUSH
C604,C605	354780109T	1 $\mu$ F50V,ELECT.		Misellaneous	
C606	354782299T	0.22 $\mu$ F50V,ELECT.		25060092	NTM-1S33,TERMINAL
C607	354741009T	10 $\mu$ F16V,ELECT.		27160029-1	RAD-07B,RADIATOR
C609	354786899T	0.68 $\mu$ F50V,ELECT.		82143006	3P+6FNBC,SCREW
C610-C614	354741009T	10 $\mu$ F16V,ELECT.		27300243	WS-2W,CLAMP
C703	354780229T	2.2 $\mu$ F50V,ELECT.		27300601	SB-1925,COVER (G/W)
C704	354741009T	10 $\mu$ F16V,ELECT.	P102	25045142	NPJ-4PDBL55
C711,C712	354742219T	220 $\mu$ F16V,ELECT.			
C715	354744709T	47 $\mu$ F16V,ELECT.			
C725	354741009T	10 $\mu$ F16V,ELECT.			
C901	3500065A	0.01 $\mu$ F400VAC,IS			
	Resistors				
R123,R124	5210122	N06HR 50KBC			
R223,R224	5210122	N06HR 50KBC			
R523,R524	5215044	N08HR 5KBC			
R573,R574	5215044	N08HR 5KBC			
R725,R726	441722704	27 $\Omega$ ,2W,OXIDE-FILM			
R727,R728	5215044	N08HR 5KBC			
R731-R734	4000112,	TD5-A090D,			
	4000118 or	TSD-090 or			
	4000119	SDT-09,THERMISTOR			

## NOTE

G : Only 220V model

W : Only Universal model

# PRINTED CIRCUIT BOARD PART LIST

NAAF-3124-1			NAAF-3126-1			
CIRCUIT NO.	PARTS NO.	DESCRIPTION	CIRCUIT NO.	PART NO.	DESCRIPTION	
Q153,Q171	Ics		P301 P302 P303,P304	Socket,Plug		
	222811 or 222502	NJM4558-DD or NJM4558-DX		25050130 25050219 25055317	NSCT-5P32 NSCT-12P47 NPLG-3P300	
C171 C173 C174,C175	Capacitors		NAAF-3126-1 CIRCUIT NO.	PARTS NO.	DESCRIPTION	
	354783399S	0.33 $\mu$ F50V,ELECT.				Ics
	354780109S	1 $\mu$ F50V,ELECT.				
	354741009S	10 $\mu$ F16V,ELECT.	Q403	222921 or 222465	BA4558 or NJM-4558D	
R155 R156	Resistors		Q404	222918	BA6251	
	5104213 5104214	N09R250KW15F,VARIABLE N09R2L50kA15F,VARIABLE	Q455 Q456 Q457,Q458	222808 222919 222918	M5218P TD-62554S BA6251	
P103 P105A P106A P107A P601A P602A P603 S601	Miscellaneous		Q401,Q402  Q451,Q452  Q453,Q454  D506-D508	Transistors          Diodes	2SD1468-R or 2SD1468-S 2SD1468-R or 2SD1468-S 2SC1815GR or 2SC945-A-P     1SS133	
	25045130	HLJ4308-01-010,MIC.JACK				
	2000521	NSAS-6P477,SOCKET				
	2000522	NSAS-6P478,SOCKET				
	2000428	NSAS-6P387,SOCKET				
	2000754	NSAS-8P710,SOCKET				
	2000524	NSAS-6P480,SOCKET				
	25045187	HLJ0541-01-010,HEADPHONE				
	25030295	NRSF-223-15MP,SWITCHS,DOL.				
	27141160A	BRACKET(VR)				
NAAF-3125-1						
CIRCUIT NO.	PARTS NO.	DESCRIPTION				
Q301  Q302 Q304 Q305 Q306	Ics		L401,L402   L403,L404   L405,L406 L451,L452	Coils 231086, 24606070 or 231041 231083, 24606080 or 231038 233314 231086, 24606070 or 231041 231083, 24606080 or 231038 231080, 233191 or 231035 231083, 24606080 or 231038 233314	NCH-2134, NCH1008 or NCH2081 NCH-2131, NCH-1022 or NCH-2078 NCH-2097 NCH-2134, NCH1008 or NCH2081 NCH-2131, NCH-1022 or NCH-2078 NCH-2128, NCH-1036 or NCH-2075 NCH-2131, NCH-1022 or NCH-2078 NCH-2097	
	222933 or 222840661	BU-4066B or 4066B				
	222917	NJM-4558S-D				
	222999	CX-20187				
	222917	NJM-4558S-D				
	222933 222840661	BU-4066B 4066B				
Q303 Q307	Transistors		L453,L454	231083, 24606080 or 231041 231083, 24606080 or 231038 231080, 233191 or 231035 231083, 24606080 or 231038 233314	NCH2081 NCH-2131, NCH-1022 or NCH-2078 NCH-2128, NCH-1036 or NCH-2075 NCH-2131, NCH-1022 or NCH-2078 NCH-2097	
	221282 221282	DTC144ES DTC144ES				
D931,D932	Diodes		L455,L456	231083, 24606080 or 231041 231083, 24606080 or 231038 231080, 233191 or 231035 231083, 24606080 or 231038 233314	NCH-2134, NCH1008 or NCH2081 NCH-2131, NCH-1022 or NCH-2078 NCH-2128, NCH-1036 or NCH-2075 NCH-2131, NCH-1022 or NCH-2078 NCH-2097	
	2243183 or 2239533	MTZ-7.5C or RD7.5E-B3				
L301,L302	Coils		L457,L458	231083, 24606080 or 231038 233314	NCH-2131, NCH-1022 or NCH-2078 NCH-2097	
	233313 or 233306	NMC6048 or NMC6043				
L303,L304	233353 or 233382	NMC-2058 or NMC-2069	L459,L460			
C301-C304 C305,C306 C327-C330 C331,C332 C335 C931,C932 C933,C944	Capacitors		C401,C402 C403,C404 C405,C406 C453,C454 C455,C456 C457,C458  R401,R402  R451,R452	Capacitors 354741009T 354781099T 354780479T 354741009T 354781099T 354780479T  Resistors 5215033 or 5215013 5215033 or	10 $\mu$ F16V,ELECT. 0.1 $\mu$ F50V,ELECT. 4.7 $\mu$ F50V,ELECT. 10 $\mu$ F16V,ELECT. 0.1 $\mu$ F50V,ELECT. 4.7 $\mu$ F50V,ELECT.  N08HR 150KBC or N08HR 100KBA N08HR 150KBC or	
	352980226S	2.2 $\mu$ F 50V,NP				
	352950476S	4.7 $\mu$ F 25V,NP				
	354780479T	4.7 $\mu$ F50V,ELECT.				
	354741009T	10 $\mu$ F16V,ELECT.				
	354780479T	4.7 $\mu$ F50V,ELECT.				
	354741019T	100 $\mu$ F16V,ELECT.				
	354744709T	47 $\mu$ F16V,ELECT.				



# PRINTED CIRCUIT BOARD PART LIST

CIRCUIT NO.	PART NO.	DESCRIPTION	CIRCUIT NO.	PART NO.	DESCRIPTION
	5215013	N08HR 100KBA	P604A	2000652	NSAS-6P608
	Miscellaneous		P707A	2000649	NSAS-10P605
P401	25050132	NSCT-7P34, SOCKET	P708A	2000798	NSAS-10P754
P402	25050217	NSCT-9P45, SOCKET	P709A	2000600	NSAS-6P556
P403, P404	25055317	NPLG-3P300, PLUG	P724A	2000781	NSAS-4P737
<b>NASW-3127-1</b>				Plug	
<b>CIRCUIT NO.</b>	<b>PART NO.</b>	<b>DESCRIPTION</b>	P721	25055150	NPLG-6P134
D721-D724	Diodes			Holder	
	223163	1SS133		27190564	HOLDER(FL)
	Switch		<b>NADIS-3130-1</b>		
S701	25065325	NSS-23128	<b>CIRCUIT NO.</b>	<b>PART NO.</b>	<b>DESCRIPTION</b>
S702	25035548	NPS-111S510, PUSH	D731	Leds	
S703-S706	25035548	NPS-111S510, PUSH	D732, D733	225192	GL1NG1
S707	25035570	NPS-111S532, PUSH		225190	GL1PR1
S708-S712	25035548	NPS-111S510, PUSH		Socket	
S713-S719	25035570	NPS-111S532, PUSH	P710A	2000739	NSAS-12P695
S720	25035399	NPS-122L364, PUSH			
	Socket		<b>NADIS-3131-1</b>		
P719A	20004782	NSAS-14P738	<b>CIRCUIT NO.</b>	<b>PART NO.</b>	<b>DESCRIPTION</b>
P720A	2000603	NSAS-12P559		Leds	
P721A	2000758	NSAS-12P714	D736	225192	GL1NG1
			D737, D738	225190	GL1PR1
			D739, D740	225192	GL1NG1
<b>NASW-3128-1</b>				Socket	
<b>CIRCUIT NO.</b>	<b>PART NO.</b>	<b>DESCRIPTION</b>	P717A	2000738A	NSAS-12P694
S721-S723	Switch	NPS-111S510, PUSH			
	25035548		<b>NADIS-3132-1</b>		
	Socket		<b>CIRCUIT NO.</b>	<b>PART NO.</b>	<b>DESCRIPTION</b>
P722A	2000515	NAAS-8P471		Leds	
			D741	225192	GL1NG1
<b>NADIS-3129-1</b>				Socket	
<b>CIRCUIT NO.</b>	<b>PART NO.</b>	<b>DESCRIPTION</b>	P716A	2000736	NSAS-4P692
Q611, Q612	Ics			Holder	
	22240087 or	BA6137 or		27190566	HOLDER(LED-1)
	22240088	LB1423N			
Q615	222687	LB1241			
Q751, Q752	22240084	HD614128S-A41			
	Transistors		<b>NADG-3133-1</b>		
Q613, Q614	2212600	DTA124ES	<b>CIRCUIT NO.</b>	<b>PART NO.</b>	<b>DESCRIPTION</b>
Q754, Q755	2211255 or	2SC1815GR or		Ic	
	2210746	2SC945AP	Q740	222810	LC7800
	Display tube			Capacitors	
Q753	212049	BG-485G	C726	354741009T	10 $\mu$ F16V, ELECT.
	Xtal			Resistors	
X731	3010118 or	CSA3.00MG or	R801	49163392404	3.9k $\times$ 4,1/10W, NETWORK
	3010129	PRS-3.00RM03	R802	49163392412	3.9k $\times$ 12,1/10W, NETWORK
	Capacitors			Socket	
C615, C616	354741009T	10 $\mu$ F16V, ELECT.	P713A	25050302	NSCT-6P129
C733	354741009T	10 $\mu$ F16V, ELECT.		Plugs	
C734	354761009T	10 $\mu$ F35V, ELECT.	P719	25055229	NPLG-7P213
	Socket		P720	25055228	NPLG-6P212

## PRINTED CIRCUIT BOARD PART LIST

CIRCUIT NO.	PART NO.	DESCRIPTION
P722	25055226	NPLG-4P210
P717,P718	25055317	NPLG-3P300

**NAETC-3134-1**  
**CIRCUIT NO.**

PART NO.	DESCRIPTION
Ics	
Q736	222740045
Q737	222465

PART NO.	DESCRIPTION
Transistors	
Q732-Q735	2211255 or 2210746

PART NO.	DESCRIPTION
Diodes	
D711,D712	223150, 223124 or 223145

PART NO.	DESCRIPTION
Capacitors	
C716,C717	352982296S
C722,C723	354741009T

PART NO.	DESCRIPTION
Plugs	
P703-1,P704-1	25055133
P708	25055149
P715	25055323

**NAETC-3135-1**  
**CIRCUIT NO.**

PART NO.	DESCRIPTION
Ics	
Q901	222780122
Q902	222790122
Q905	222780052

PART NO.	DESCRIPTION
Transistors	
Q903	2201275 or 2201276
Q904	2201285 or 2201286

PART NO.	DESCRIPTION
Diodes	
D901-D904	223894
D905-D907	223891F
D908,D909	223163
D910	2243242, 2239652 or 224651302

PART NO.	DESCRIPTION
Capacitors	
C902,C903	354751029S
C904	354781099T
C905	354780109T
C906	354751029S
C907,C908	354744709T
C909	3504211S
C910	354782299T
C911	354781099T
C912-C914	354780479T

CIRCUIT NO.	PART NO.	DESCRIPTION
	Resistors	
R901	442524794	RS1/2WBJ 0.47 $\Omega$ ,OXIDE-FILM
R902	442520224	RS1/2WBJ 2.2 $\Omega$ ,OXIDE-FILM
R903	442524714	RS1/2WBJ 470 $\Omega$ ,OXIDE-FILM
R904	441723904	RS 2 WBJ 39 $\Omega$ , OXIDE-FILM
R908	442520104	RS1/2WBJ 1.0 $\Omega$ ,OXIDE-FILM

PART NO.	DESCRIPTION
Plugs	
P911,P912	25055136

PART NO.	DESCRIPTION
Miscellaneous	
27160271-1	RAD-68B,RADIATOR
27160029	RAD-07,RADIATOR
82143006	3P+6FN(BC),SCREW

**NASW-3136-1**  
**CIRCUIT NO.**

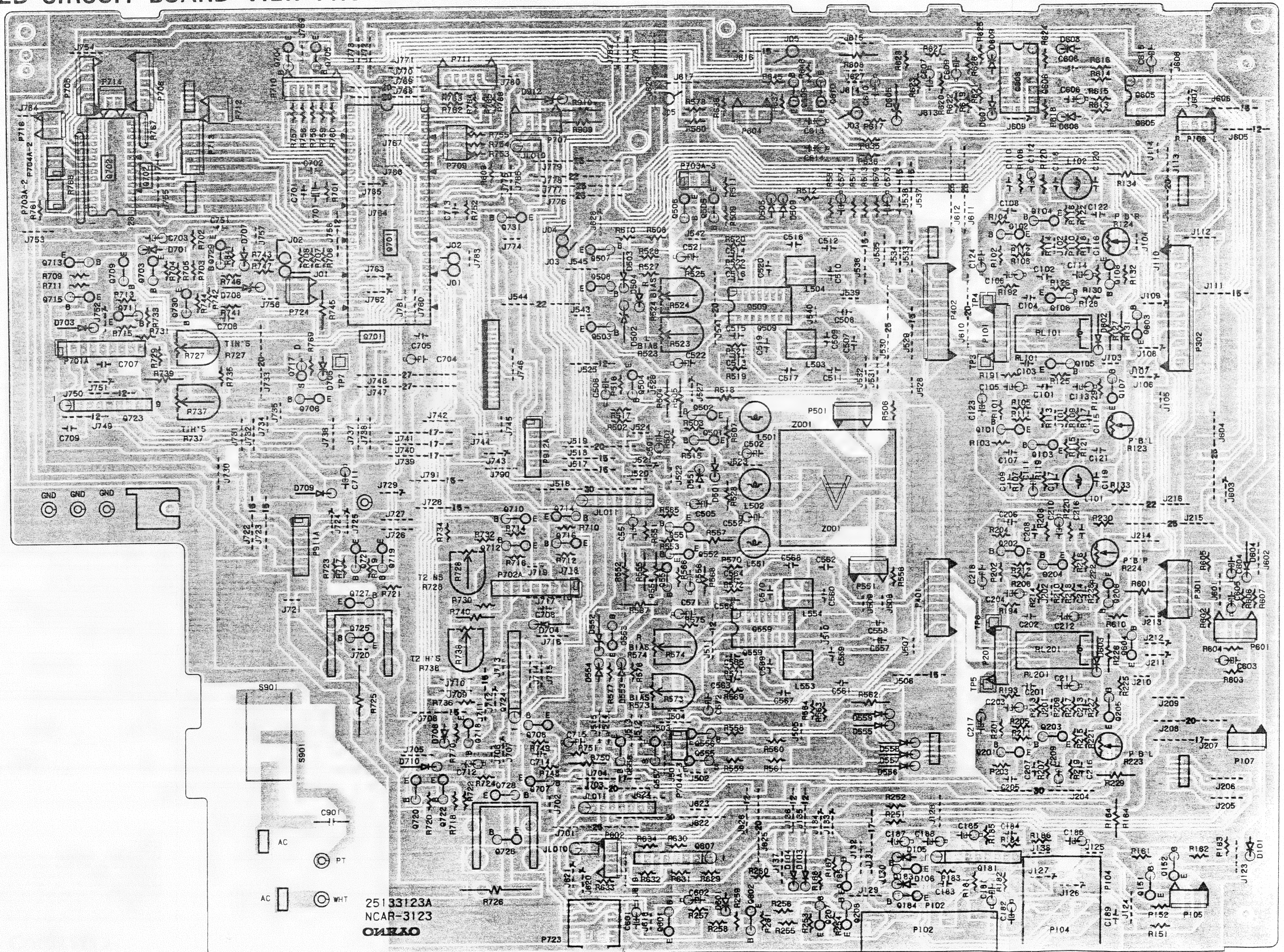
PART NO.	DESCRIPTION
Switch	
S724	25035548

PART NO.	DESCRIPTION
Socket	
P712A	2000736



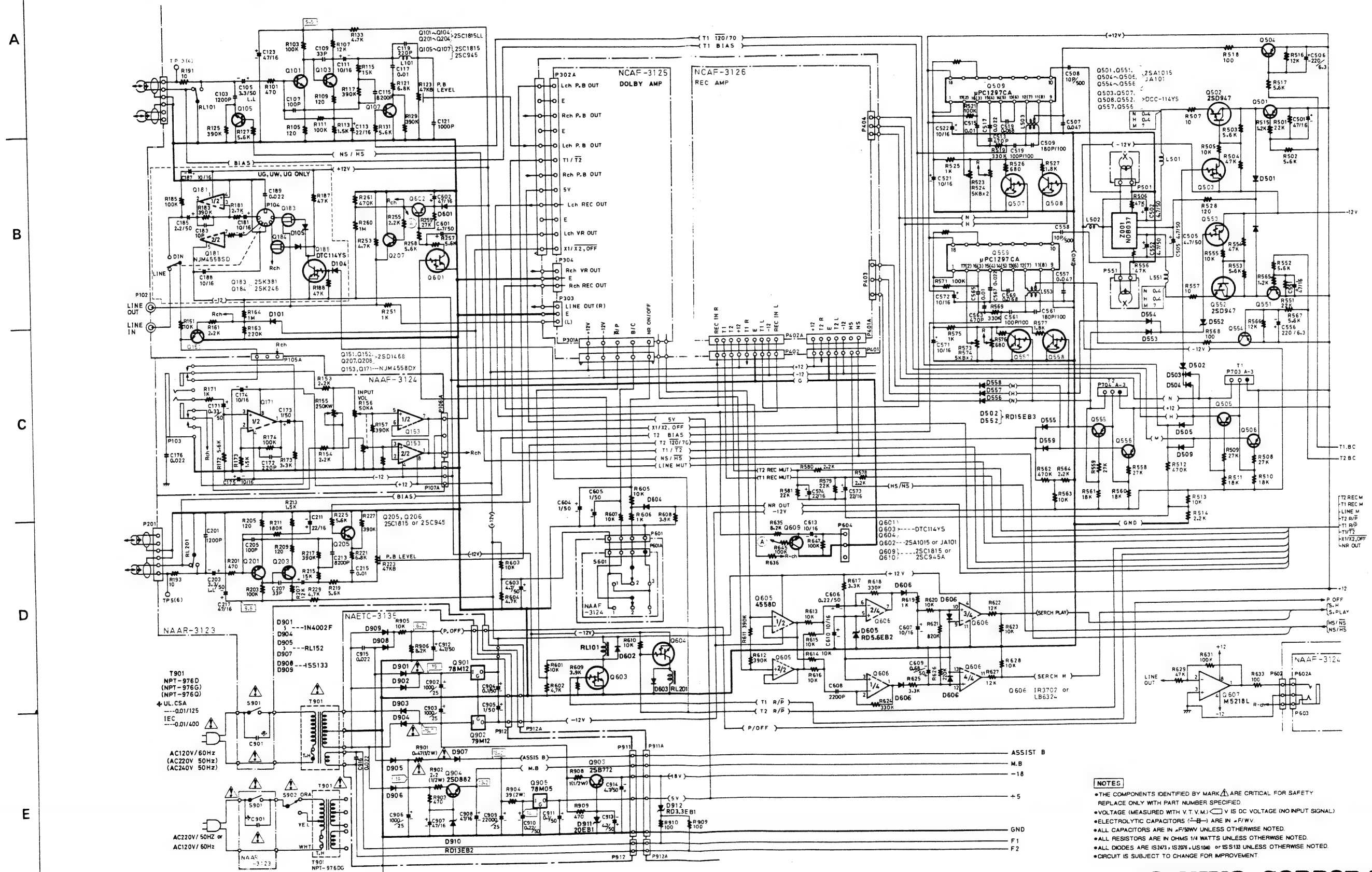
## PRINTED CIRCUIT BOARD VIEW FROM BOTTOM SIDE

NCAR-3123



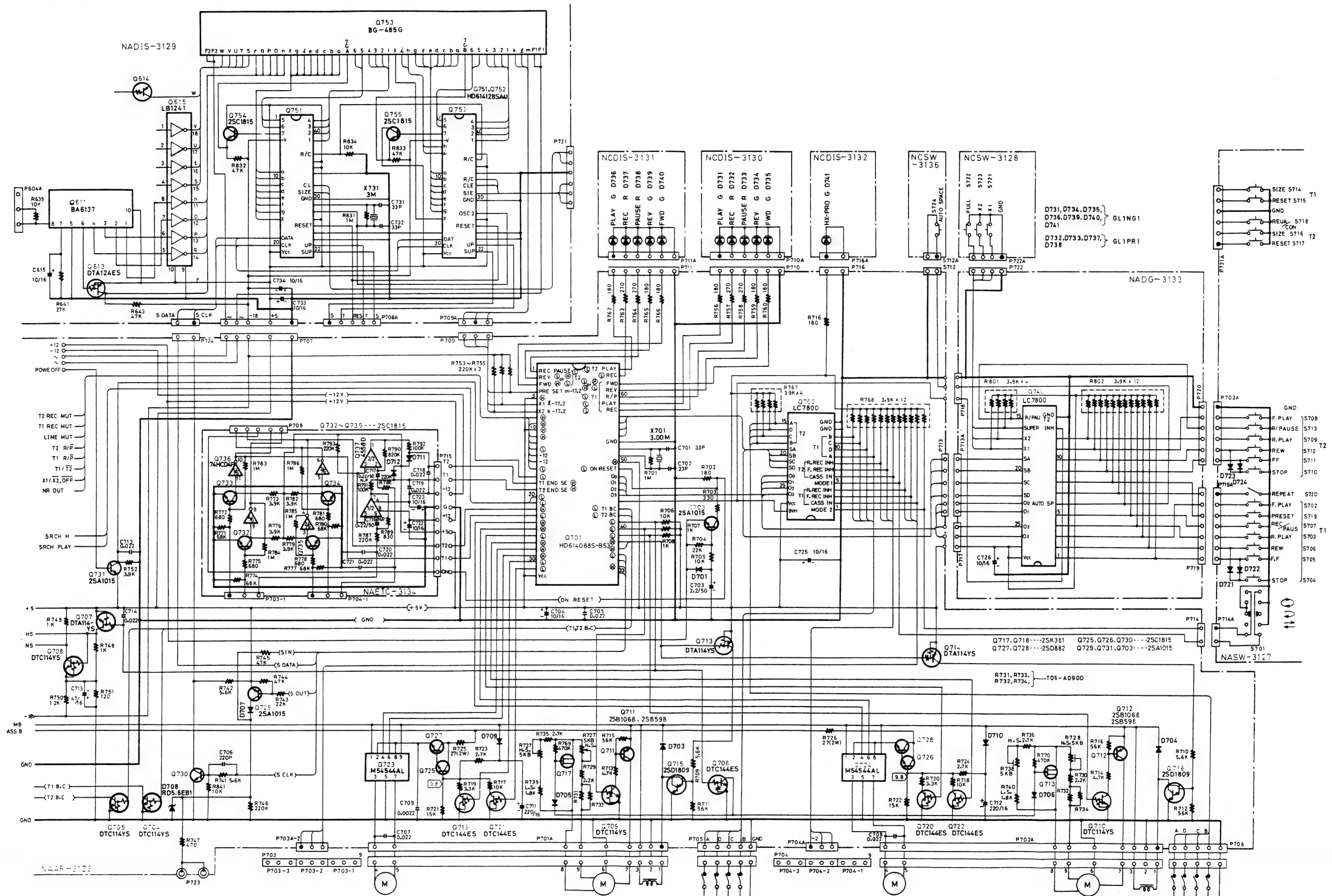


### SCHEMATIC DIAGRAM (AUDIO SECTION) 1/3



**ONKYO CORPORATION**

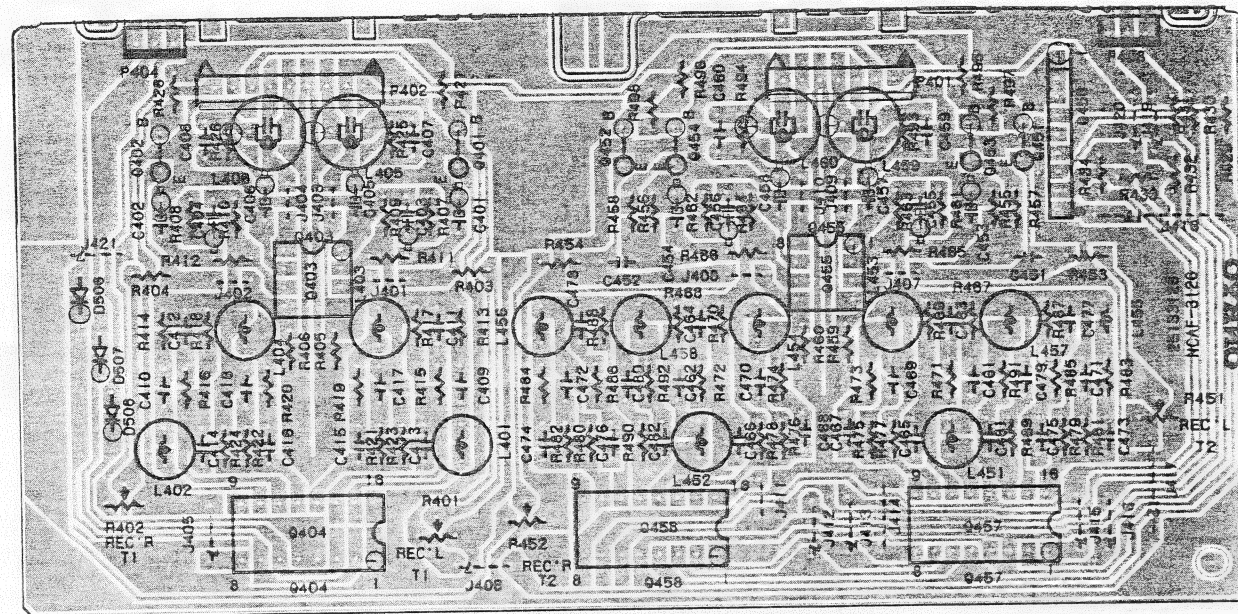
## SCHEMATIC DIAGRAM (CONTROL SECTION) 2/3



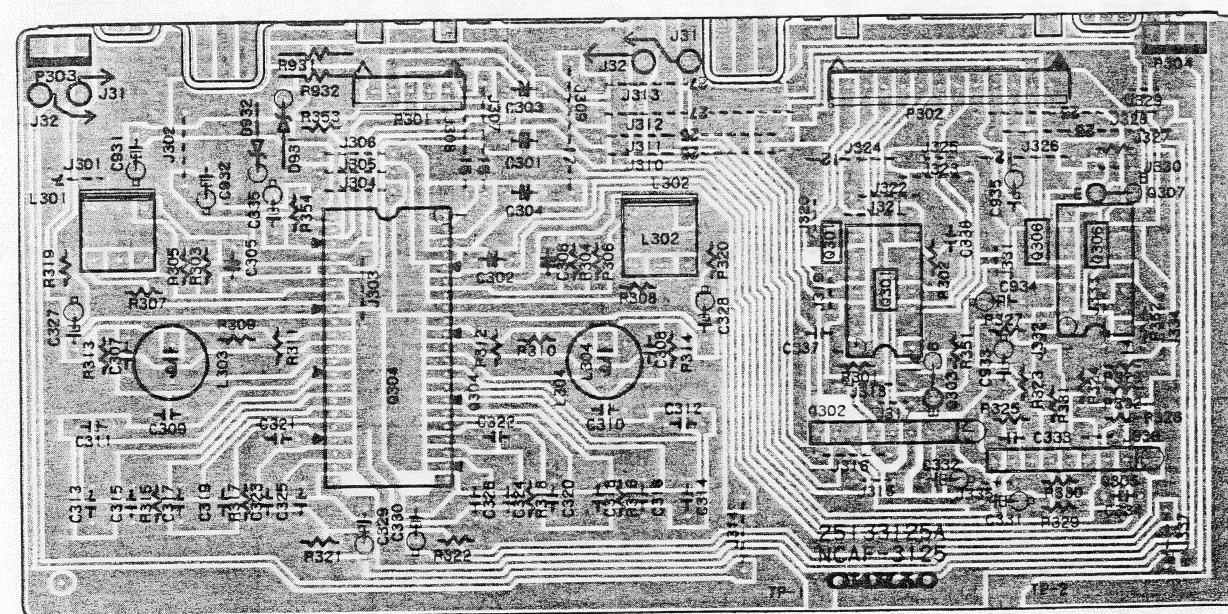


PRINTED CIRCUIT BOARD VIEW FROM BOTTOM SIDE

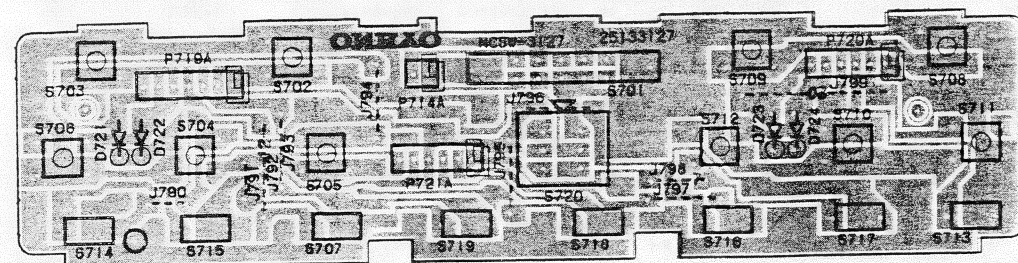
NCAF-3126



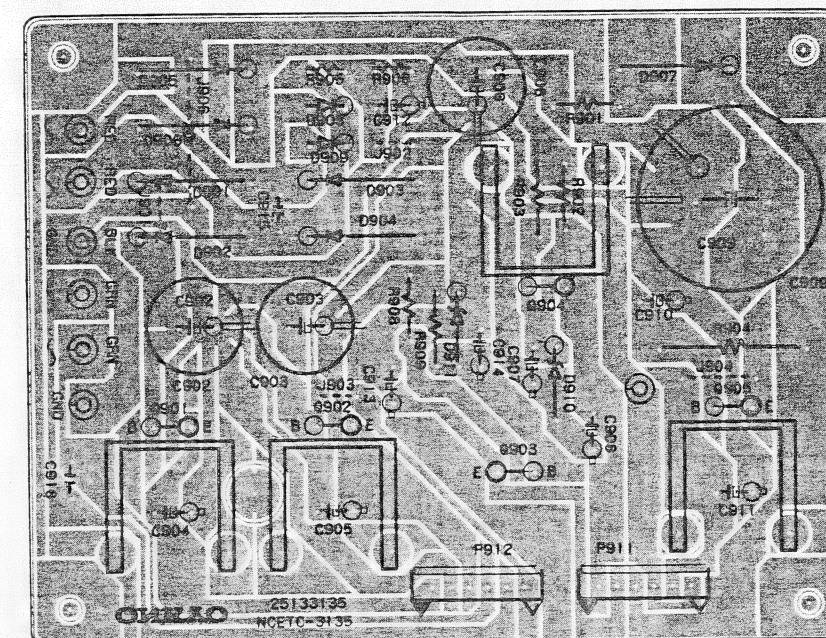
NCAF-3125



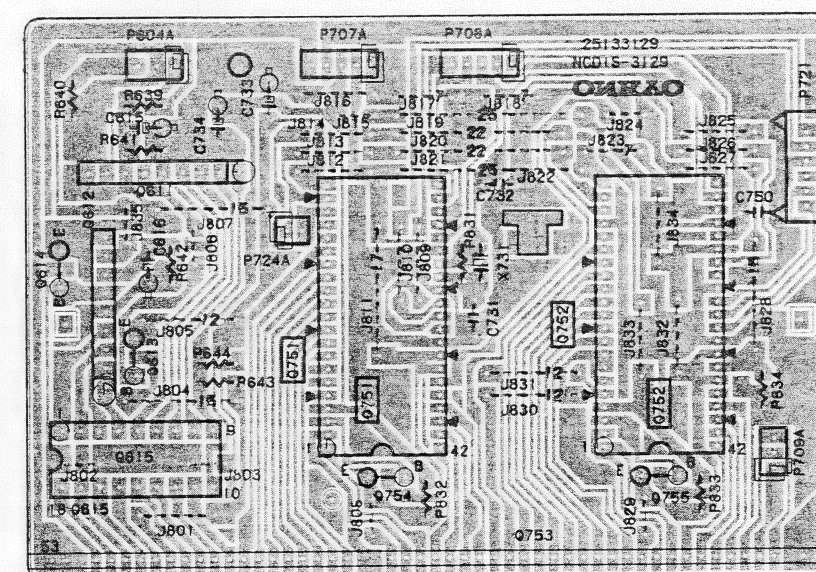
NCSW-3127



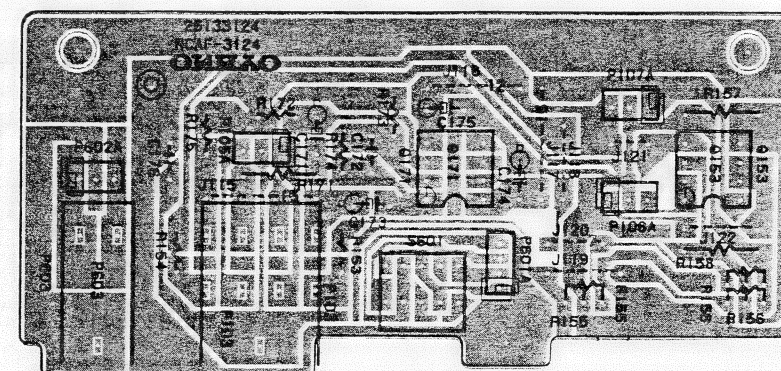
NCETC-3135



NCDIS-3129

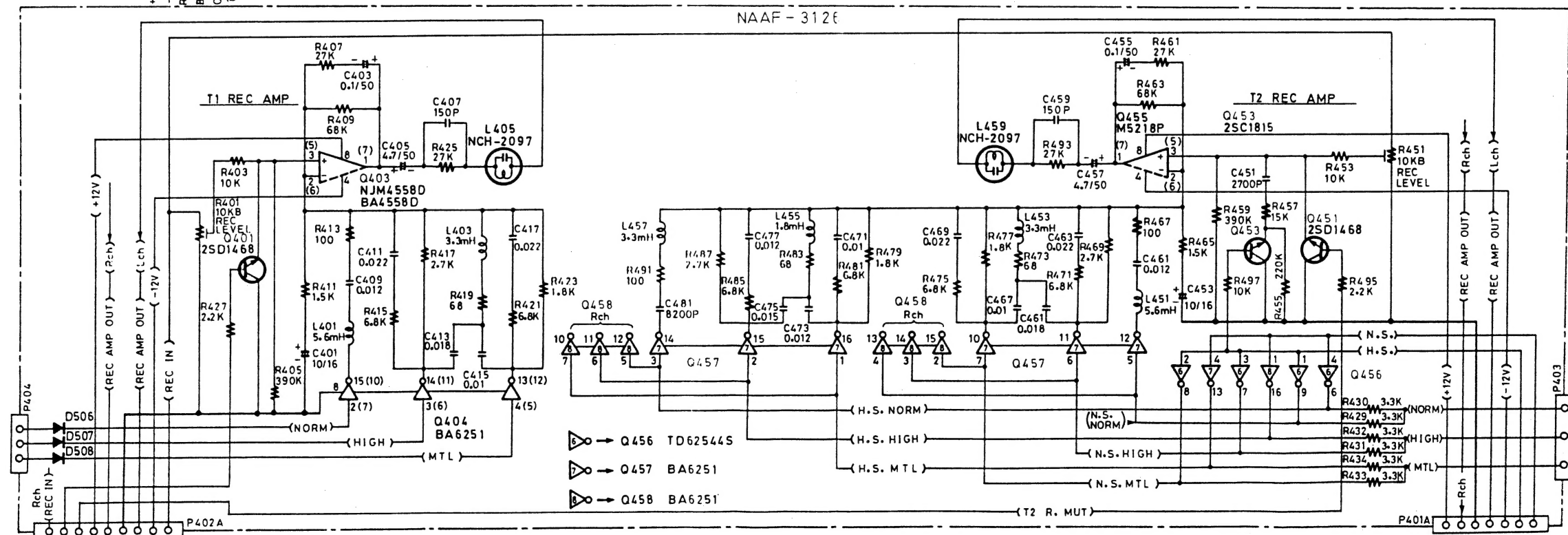
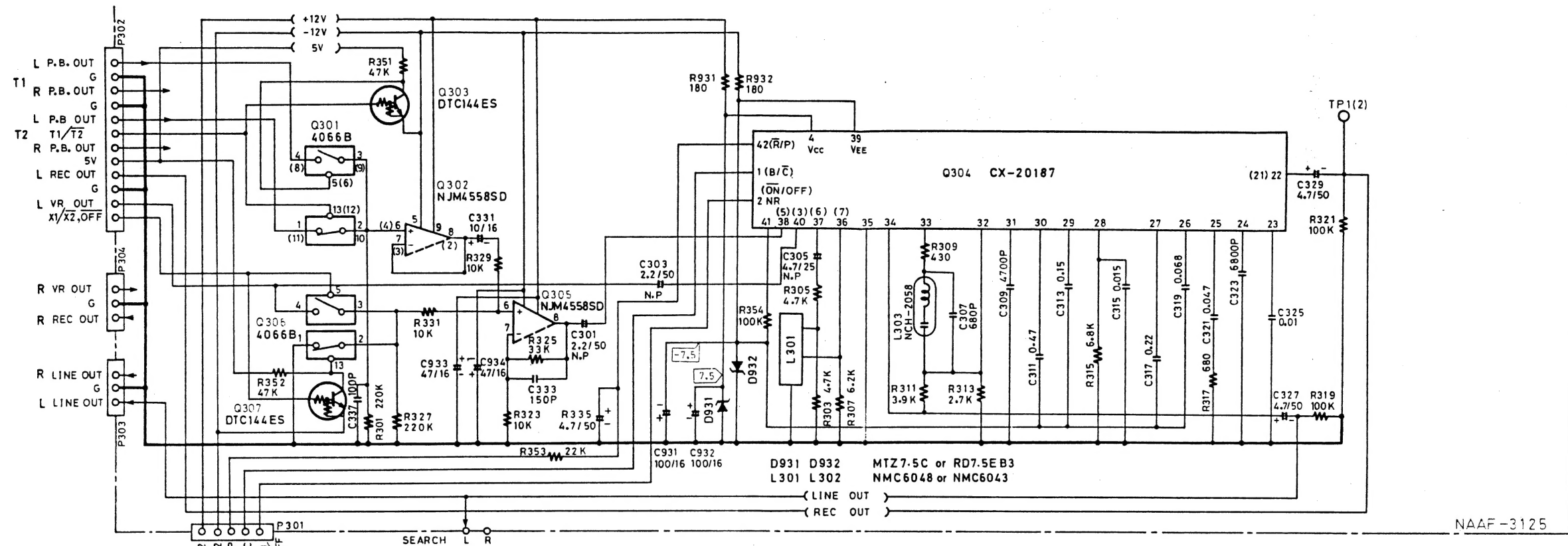


NCAF-3124





**SCHEMATIC DIAGRAM (REC AMP. DOLBY NR SECTION) 3/3**

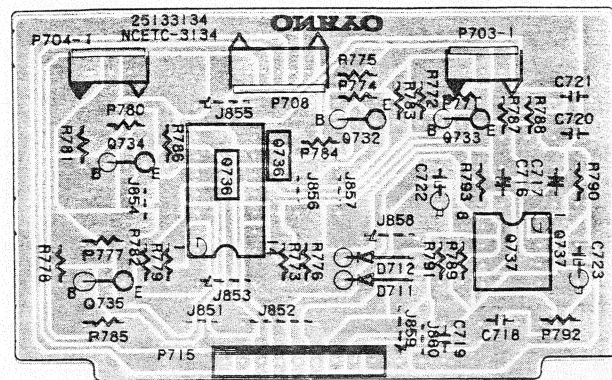


**ONKYO CORPORATION**

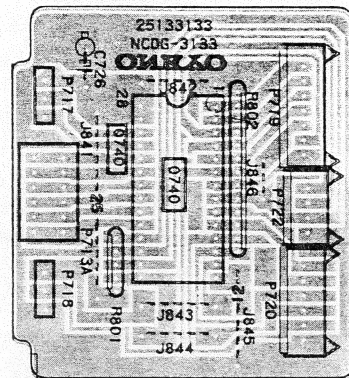


## TAPE MECHANISM-PART LIST

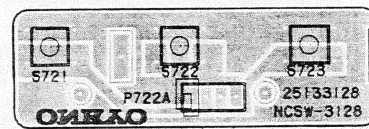
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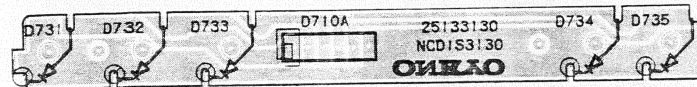
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NCSW-3128

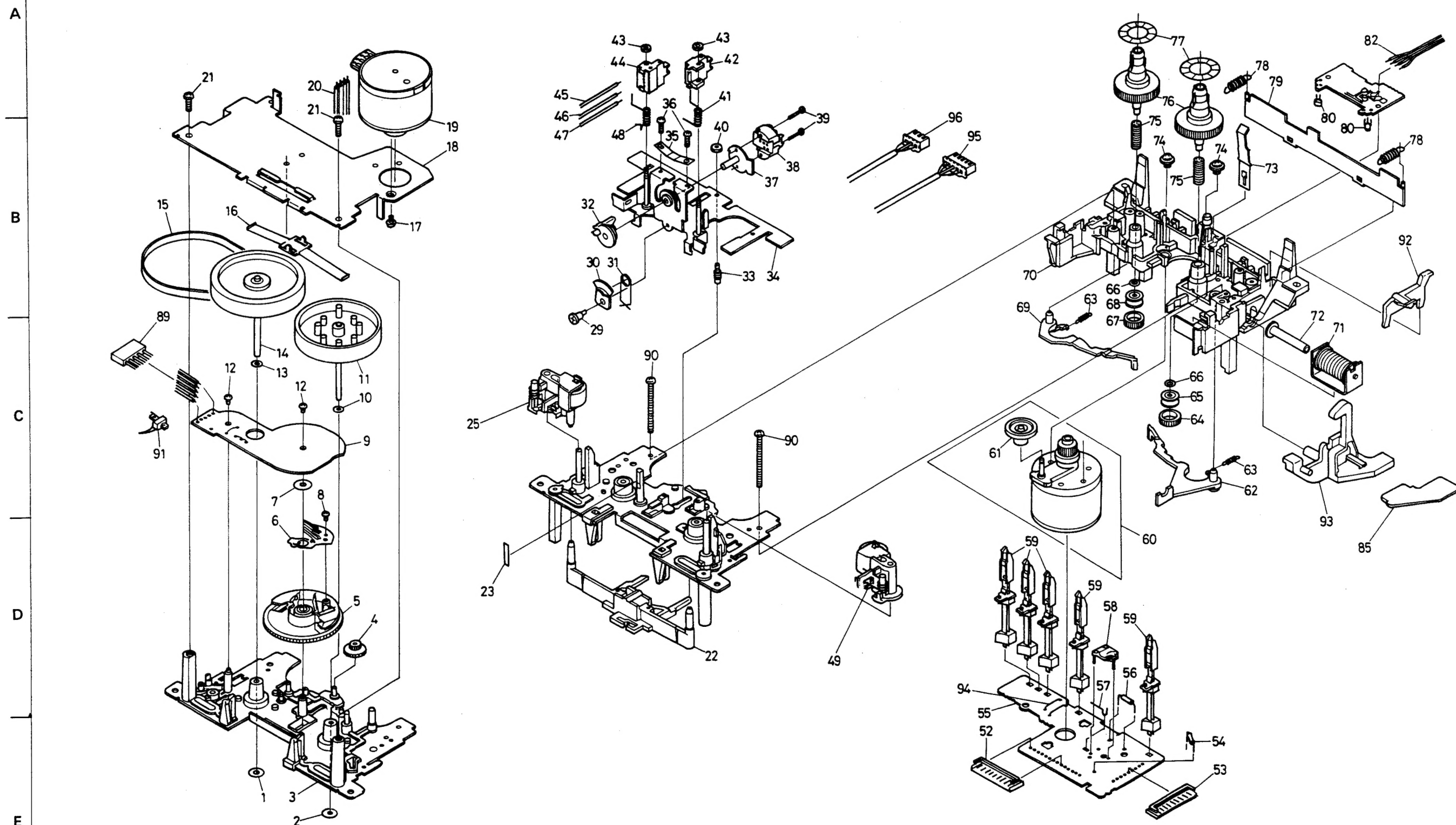


NCDIS-3130

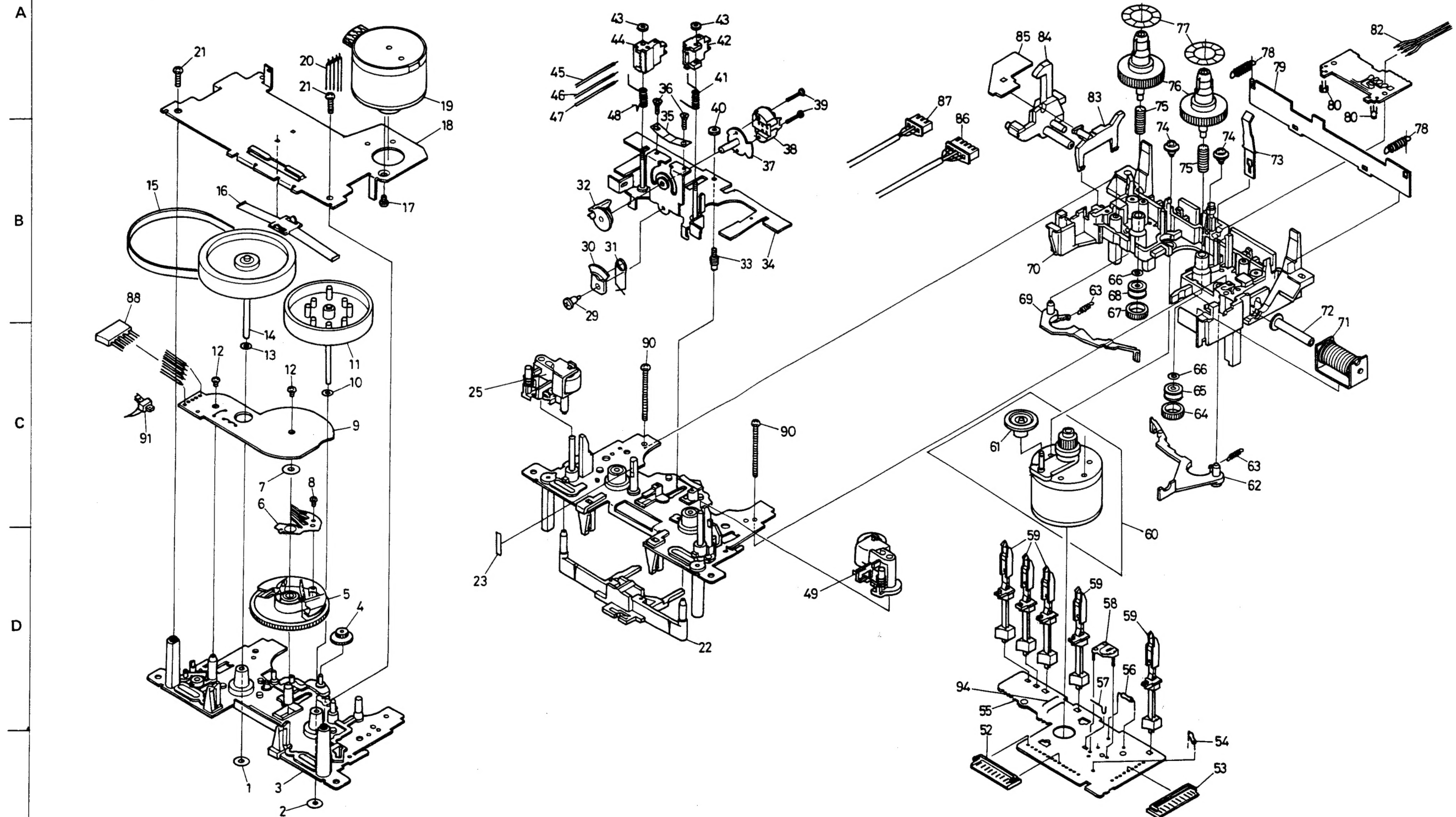




## TAPE MECHANISM-EXPLODED VIEW (TAPE-1)



## TAPE MECHANISM-EXPLODED VIEW (TAPE-2)

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